CHARACTERIZATION AND QUANTIFICATION OF NONPOINT-SOURCE POLLUTANT LOADS IN A CONDUIT-FLOW-DOMINATED KARST AQUIFER UNDERLYING AN INTENSIVE-USE AGRICULTURAL REGION, KENTUCKY:

FINAL REPORT FOR PHASE II

UKRF #427303

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March 1, 1995

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May 4, 1995

Ms. Corrine Wells, Supervisor
Nonpoint-source Pollution Section, Division of Water
Natural Resources and Environmental Protection Cabinet
Fort Boone Plaza, 18 Reilly Road
Frankfort, Ky. 40601

Dear Ms. Wells,

Enclosed are copies of the close-out and final reports on Phase II of the Logan County 319 study, Characterization and Quantification of Nonpoint-source Pollutant Loads in a Conduit-Flow-Dominated Karst Aquifer Underlying an Intensive-Use Agricultural Region, Kentucky. As I mentioned in my letter of March 31, 1994, the report includes all findings of Phase I and Phase II. The report was delayed from the December 31, 1993 due date mentioned in the memorandum of agreement (dated September 1, 1992) because funding was not received at KGS until June 1993. Further delays were caused by an unanticipated and extraordinary level of effort necessary to respond to natural calamities, ie. lightning and flood damage to equipment.

Despite all of the administrative and weather hassles, I believe KGS has very successfully completed its obligations in quantifying the mass flux of agricultural chemicals from Pleasant Grove Spring. The report has been formatted to the traditional water year to make it more easily compatible with other hydrogeologic reports and to synchronize it with the growing seasons. After editing, the report will be published as a KGS Report of Investigations. I will supply you with several copies of the published report when they become available.

Please call me if you have any questions or need further documents.

Cordially,

James C. Currens

James. C. Currens
Water Resources Section

enclosure
cc. Mr. David Leo, Manager
Ground Water Branch, Division of Water
Dr. Jim Dinger, KGS
Mr. Todd Coleman, UKRF

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James C. Currens

ABSTRACT

The ultimate goal of this study is to demonstrate whether a program to improve Best Management Practices (BMP's) on farms overlying a karst aquifer will improve ground-water quality. This study is divided into three phases. Included in this report are the results of Phase I and Phase II, which focus on water-quality monitoring before BMP implementation. The Pleasant Grove Spring Basin in southern Logan County, Ky., was selected for study because it is largely free of non-agricultural pollution sources. The drainage basin area was determined by ground-water dye tracing and is approximately 10,291 acres (4,165 hectares). About 92 percent of the watershed is in agricultural production. Ground-water flow in the basin is divided into a diffuse (slow-flow) regime and a conduit (fast-flow) regime. The diffuse and conduit flow regimes have a major influence on the timing of contaminant peaks and valleys in storm-event chemographs. Nitrate is the most widespread, persistent contaminant in the basin, but concentrations do not exceed maximum contaminant levels (MCL's) for drinking water. Atrazine has been consistently detected in low concentrations, and other pesticides occasionally occur. Triazines (including atrazine) and alachlor have exceeded drinking water MCL's during spring flooding. Flow-weighted average concentrations for 1992-93 were 4.91 µg/L for atrazine and 5.0 mg/L for nitrate-nitrogen. Averages for 1993-94 were 0.97 µg/L and 5.7 mg/L, respectively. Bacteria counts occasionally exceed standards for drinking-water supplies. Bacteriological speciation failed to identify the source of high bacteria counts at Pleasant Grove Spring, but show the bacteria are not of indigenous origin. Suspended sediment discharging from Pleasant Grove Spring has had an adverse impact on aquatic biota downstream.

INTRODUCTION

Karst aquifers are the water-bearing zones in terranes characterized by sinkholes, sinking streams, and caves. Ground water in karst aquifers occurs in partially to completely filled caverns, joints, and other fractures in the otherwise relatively impermeable limestone bedrock, and in soil mantling the solution-etched bedrock. Almost all ground water in karst basins eventually flows into caverns, from which it flows to discharge at a spring. Karst aquifers are notoriously sensitive to ground-water pollution because runoff from contaminant sources on the surface often directly enters the aquifer through sinking streams and sinkholes, without filtration. The most productive agricultural region in Kentucky follows the karst plain that extends in a belt from west-central Kentucky, south to the Tennessee line, then west across the southwestern quarter of the State. Large farms produce corn, wheat, soybeans, tobacco, and other small grains from the thick and fertile soil overlying a gently rolling landscape. Logan County, the location of this study, produced over $71 million of crop and livestock receipts in 1992, making it the sixth-ranking county in the State (Kentucky Agricultural Statistics Service, 1993). Not coincidentally, in these same areas occur some of the most serious ground-water contamination problems in the State (Nitzkin and Henry, 1971; Kentucky Division of Water, 1988). Recently, water supply has become a significant limitation on economic development in the region.

PURPOSE AND SCOPE

Production techniques and farm management strategies to protect both surface and ground water and to minimize soil erosion have been developed and tested at plot, field, and farm scales. The Pleasant Grove Spring karst ground-water basin was chosen to test whether a program to install new or modified Best

Management Practices (BMP's) and an education program to enhance public attitudes about ground water will improve the ground-water quality of a karst ground-water basin at a large scale. This report summarizes the results of Phase I (field reconnaissance and watershed mapping) and Phase II (pre-BMP water-quality characterization and quantification). This report summarizes data collected between August 1990 and October 1994. Additional data are available through the Kentucky Hydrologic Data Base at the Kentucky Geological Survey.

This research is important because agricultural chemicals have been detected in municipal water supplies, as well as in ground water. The presence of the chemicals has raised public concerns about the safety of drinking water. In karst areas, springs supply a substantial percentage of flow to surface streams. However, the regulation of farming practices would lessen productivity and increase the cost of food. If programs and farming practices already in existence can be used to effectively protect ground water, without regulation, then both the public safety and the independence of farmers can be protected.

Support for project development and initial site reconnaissance during the summer of 1990 was through the Kentucky Geological Survey, University of Kentucky. Reconnaissance sampling and watershed mapping began in February 1991 when funding was received through the University of Kentucky College of Agriculture from Kentucky Senate Bill 271. Most equipment purchases and roughly half of the analytical costs were paid for by SB 271 funds. Additional funding was received in April 1992 through the Kentucky Division of Water (Memorandum of Agreement 011399) from the U.S. Environmental Protection Agency's Nonpoint-Source Program (Section 319 of the Clean Water Act). Phase II funding was received in September 1993, also through the 319 program (Memorandum of Agreement 012875). Additional support has been received from the Kentucky Geological Survey since June 1994.

STUDY AREA DESCRIPTION

General Setting

The study area is centered in south-central Logan County, and Pleasant Grove Spring is about 9 miles (14.5 km) south of Russellville, Ky. (Fig. 1). The study area includes portions of the Russellville, Dennis, Dot, and Adairville 7.5-minute quadrangles. Pleasant Grove Creek flows south 1.5 miles (2.4 km) to the Red River from its origin at Pleasant Grove Spring. For this report, reaches of surface flow in the headwaters area of the basin, upstream of major swallow holes, are collectively called Upper Pleasant Grove Creek.

The study area is mature karst, with abundant sinkholes, sinking streams, karst windows, and springs. Flow on the surface persists in the northern end of the study area through most of the year, gradually ceasing headward as drought periods lengthen. Flow in the southern end of the basin is exclusively underground, except during extreme high flow, where scattered deep sinkholes allow access to flowing water. Manmade ponds and naturally plugged sinkholes provide additional water supplies for livestock. Some residents have recently obtained public water supplies, but most still use wells. Land use in the basin is almost entirely agricultural. The primary row crops are corn, wheat, and soybeans in a 2-year rotation (Fig. 2). Minor crops include hay, tobacco, milo, and other small grains. Livestock production includes beef and dairy cattle and swine.

Chemical Use

Modern agricultural practices require the use of large amounts of herbicides, insecticides, and fertilizers. No-till cropping, a method of killing non-crop plants with herbicides instead of plowing, is perhaps the most effective technique used by farmers to minimize soil erosion. Over 67,000 pounds (30 metric tons) of atrazine alone are sold in Logan County annually (Ernest Collins, Kentucky Division of Pesticides, personal communication, 1993). Application rates recommended by the U.S. Department of Agriculture for the South Logan County Conservation District and by the University of Kentucky College of Agriculture were used to estimate loss percentages. The average recommended application rate for all crops for nitrogen fertilizer for the Pleasant Grove Spring Basin is 137 lbs./acre (154 kg/hc) nitrate-nitrogen and the recommended rate of atrazine for corn is 2.5 lbs./acre of 80 percent active ingredient (2.8 kg/hc). Pesticide application rates are summarized in Table 1.

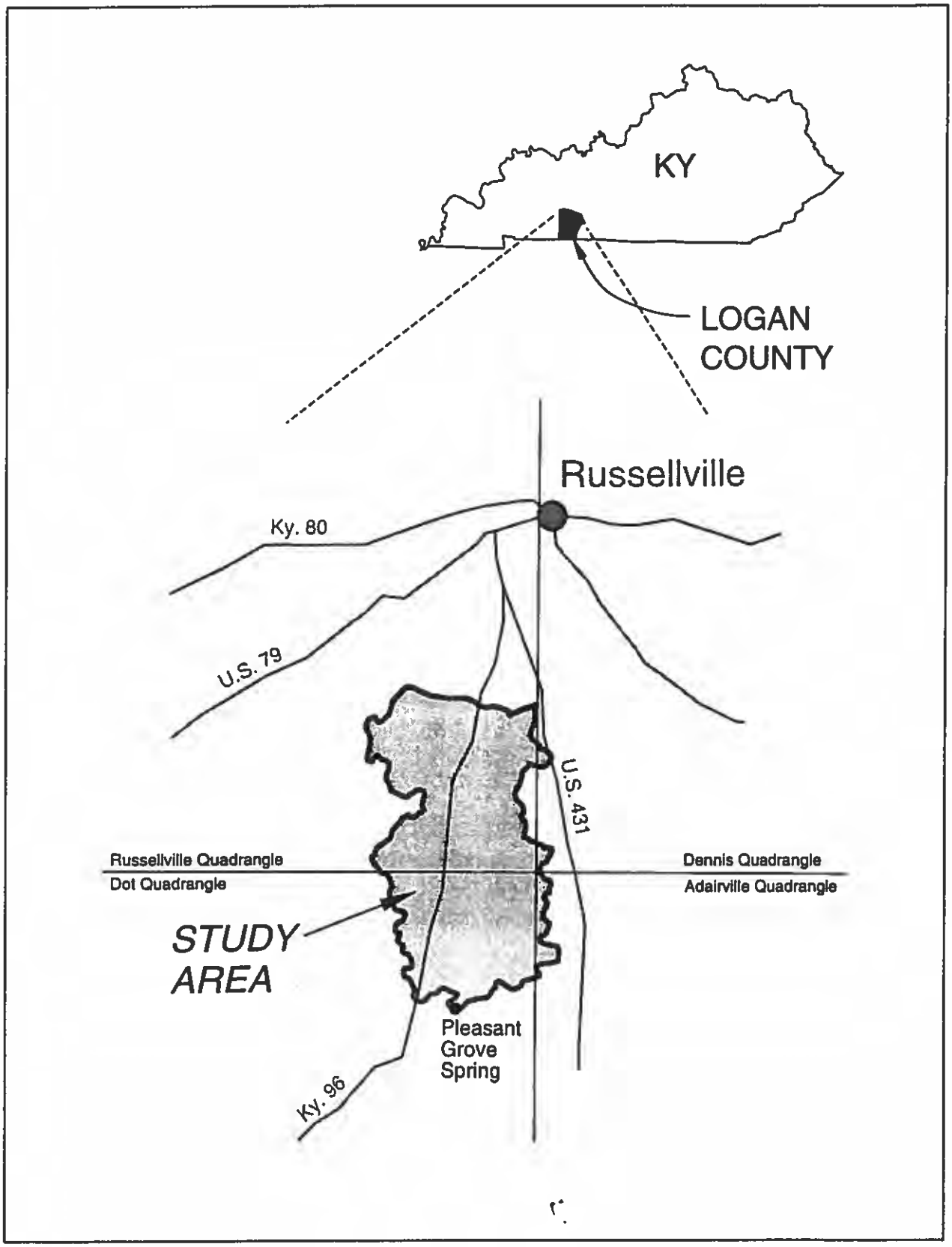

Figure 1. Location of the Pleasant Grove Spring drainage basin.

Figure 2. Example of a large crop field in the study area.

Table 1. Purpose and application rates for pesticides commonly used in Logan County (1992 sales greater than 2,200 lbs.) that are detectable by the Kentucky Geological Survey Water-Quality Laboratory.

Pesticide	*Purpose*	*Application Rate Maximum per Acre**	*Time of Application*
atrazine	corn, pre-emergent herbicide	2.5 lbs. at 80%	mid-April
butylate	corn, pre-plant herbicide	7 pints	early April
metolachlor	corn, pre-emergent herbicide	2 pints	
alachlor	corn, pre-emergent herbicide	2 pints	
cyanazine	corn, pre-plant herbicide	2 quarts	April
pendimethalin	corn, pre-emergent herbicide	3 pints	April
carbofuran	corn, insecticide	5 lbs.	May and June
permethrin	soybean, insecticide	6.8 oz.	
linuron	soybean, pre-emergent herbicide	1 lb.	
trifluralin	soybean, pre-plant herbicide	2.25 pints	
chlorpyrifos	soybean, insecticide	1.5 pints	June and July
2,4-D	corn, post-emergent herbicide	1.5 pints	May and June
endosulfan I & II	tobacco, insecticide		

*Martin and Green, 1992; Bill Johnson, NRCS Logan County Office, personal communication, 1992

Geology and Hydrogeology

Pleasant Grove Spring Basin lies entirely within the Pennyroyal Plateau, which is developed on thick carbonates of Late Mississippian age. Previous hydrogeologic investigations in the area are highly generalized (Brown and Lambert, 1962; Van Couvering, 1962). Pleasant Grove Spring was sampled by the U.S. Geological Survey in 1982 (Rene Garcia, personal communication, 1994). The geology of the area was mapped by Rainey (1965), Shawe (1966a-b), and Miller (1968). Only two mapped units, the St. Louis Limestone and the overlying Ste. Genevieve Limestone, occur at the surface in the basin. Exposures of these units are generally poor. The upper 70 feet (21 m) of the St. Louis Limestone is exposed along stream channels and in deep sinkholes in the southern end of the basin. Although the St. Louis Limestone is a relatively pure, thick-bedded, oolitic to micritic limestone, it also contains thin, argillaceous-carbonate and shale beds and both bedded and nodular chert. Because of limited outcrop and drillhole data, the formational boundary with the overlying Ste. Genevieve is mapped at the highest occurrence of a relatively thick and widespread horizon of chert. This unit is probably the stratigraphic equivalent of the Lost River Chert (Garland R. Dever, Jr., Kentucky Geological Survey, personal communication, 1994).

The Ste. Genevieve Limestone is a very pure, thick-bedded, oolitic to micritic limestone with scattered, thin-bedded chert layers, primarily near its base. The lower 197 feet (60 m) of the Ste. Genevieve Limestone are exposed in the basin.

The strata dip gently to the northwest at 60 feet per mile (11.4 m/km) (Fig. 3) into the Illinois structural basin. No faults are mapped within the drainage basin; however, significant faulting occurs to the north, and obvious lineaments of sinkholes within and near the basin suggest the possibility of unmapped faults.

Soils

Soils in the basin are Pembroke-Crider association, derived from loess and limestone residuum (Dye and others, 1975). They are silt loams, moderately permeable, with deep root zones. The soils may be as much as 76 inches (1.93 m) thick to the base of the subsoil. Except where loess is preserved, the soils exhibit the terra rosa coloration typical of karst, especially in the subsoil, suggesting significant iron content.

PREVIOUS RESEARCH

The leaching of agricultural chemicals from soils or into ground water in non-karst settings has been documented for decades (Lichtenstein, 1958; Johnston and others, 1967; Dao and others, 1979; Thomas and Phillips, 1979; Cohen and others, 1986; Canter, 1987; Libra, 1987; Wartenberg, 1988; Magette and others, 1988; Smith and others, 1988). The mechanisms of movement and the relative significance of leaching in various soils and agricultural settings are subjects of several papers (Thomas, 1972; Thomas and Phillips, 1979; Cohen and others, 1986; Canter, 1987; Smith and others, 1988). However, none of these studies was specifically di-

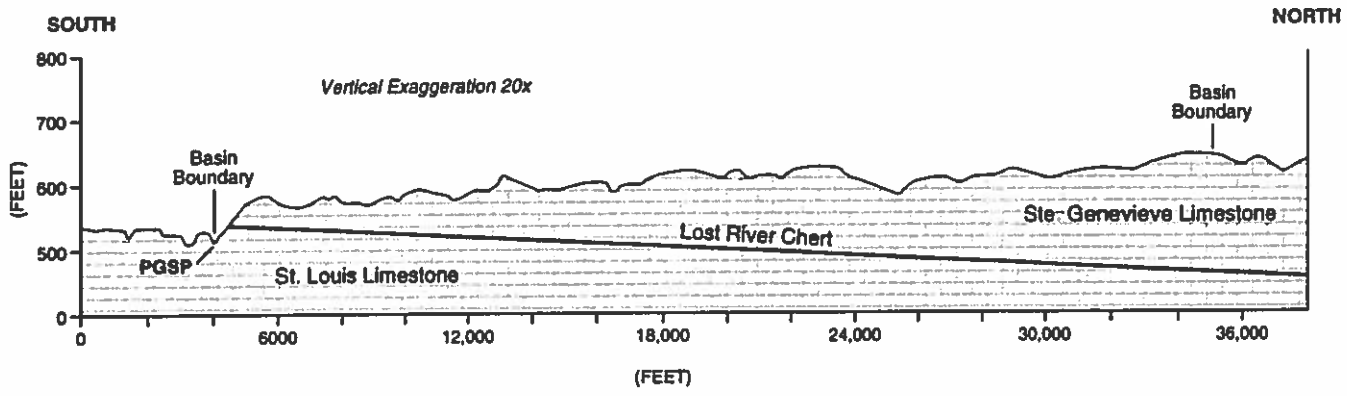

Figure 3. South-north geologic cross section of the study area showing the approximate position of the Lost River Chert (after Cupp, 1994).

rected toward the special hydrogeologic conditions of karst.

Studies of field runoff into streams have shown adverse impacts by agricultural chemicals where soil erosion is high (Sharpley and Syers, 1979; Baker, 1980). Because karst conduits can transport significant quantities of sediment, agricultural chemical adsorption on soil particles and their subsequent erosion may play a significant role in contaminant transport in karst aquifers. Therefore, karst aquifers may be doubly contaminated from direct runoff and diffuse infiltration.

The presence of agricultural chemicals in karst ground water in concentrations warranting concern has only recently been questioned. Several widely published studies investigating agricultural chemicals in a karst aquifer were conducted in the Big Spring Basin, Iowa (Hallberg and others, 1983, 1984; Libra and others, 1986). Big Spring discharges from the Galena aquifer, which has a significant diffuse-flow component characterized by fewer direct inflows and relatively long residence times. Hallberg and others (1983, 1984) and Libra and others (1986) found that nitrate occurred in significant concentrations (flow-weighted mean of 45 mg/L as nitrate), while atrazine never exceeded 5.1 µg/L and averaged 0.28 µg/L. Nitrate infiltration was thought to be related to diffuse recharge, while atrazine infiltration was induced by inflow to sinkholes and sinking streams. A seasonal cycle in nitrate concentration was observed. Studies by Boyer and Pasquarell (1994) and Steele and Smith (1994) found a direct relationship between aquifer vulnerability, land use, and agricultural chemical concentrations. Studies in Kentucky on agricultural nonpoint-source pollution in karst aquifers prior to 1991 are Masters theses (Devilbiss, 1981; Tucker, 1982; Brown, 1985). Tucker (1982) found that nitrate concentrations increased during high-flow events and that sediment and bacteria discharges were significant. Brown (1985) found that nitrate concentrations decreased during high flow. Both authors noted seasonal cycles in nitrate concentration. Recent nonpoint-source pollution studies in karst basins currently underway in Kentucky include the Mammoth Cave Water-Quality Special Project (Meiman, 1991) and several projects sited in the Inner Blue Grass Region (Felton, 1991; Hampson, 1994; Keagy and others, 1994a–b). Meiman (1991) correlated land use with water quality and noted the presence of triazines during spring storms, and high bacteria levels in watersheds draining areas that included both agriculture and suburban development. Felton (1991) found that nitrate varied seasonally at Garretts Spring, but pesticides occurred only in very low concentrations. Hampson (1994) and Keagy and others (1994a–b) found several pesticides and nitrate in wells.

METHODOLOGY

General Strategy

The purpose of this research is to measure changes in water quality in a karst ground-water basin used intensively for agriculture, before, during, and after the implementation of BMP's and other management practices, and to determine the success of such programs in protecting ground water. Logistics, a limited budget, and public relations had a major influence on project design. For example, an annual census of actual pesticide application in the basin would have had both a poor response and created an atmosphere of distrust among farmers. Also, because of the size of the watershed, such a detailed survey was beyond budgetary limitations.

Changes in water quality were determined by following trends in mean concentrations, flow-weighted means, and annual mass flux of contaminants over several years. The total annual mass flux of suspected contaminants was estimated by multiplying discharge calculated from stage records by concentrations determined by analysis of samples. The pre-BMP mass flux was determined for 2 full years to provide a basis for estimating variability in the flux. Although longer pre-BMP monitoring would have been desirable, it was not practical due to cost. Implementation of BMP's and other management practices began in the spring of 1995. Over the course of monitoring during the 3-year BMP implementation period, changes in the quality of water discharging from Pleasant Grove Spring should become apparent. The trends in mass flux, and in the concentration of less quantifiable contaminants, should indicate the success or failure of the BMP program.

Ground-Water Dye Tracing

Springs and suitable input points for ground-water dye tracing were searched for during field reconnaissance. Over 70 karst features (sinking streams, caves, springs, estavelles, and sinkholes) were located, and many were utilized during the tracing program. A boat was used to locate springs along Whippoorwill Creek and Little Whippoorwill Creek. Many features were reported by area residents, and several features were located from aerial photographs.

Ground-water basin boundaries were mapped by conducting ground-water dye traces to Pleasant Grove and surrounding springs. Standardized tracing techniques discussed in detail by numerous authors were

used (Aley and Fletcher, 1976; Thrailkill and others, 1983; Jones, 1984; Davis and others, 1985; Quinlan, 1987; Mull and others, 1988). The traces utilized four fluorescent dyes: Fluorescein (C.I. Acid Yellow 73), Rhodamine WT (Acid Red 388), Diphenyl Brilliant Flavine (C.I. Direct Yellow 96), and Tinopal CBS-X (optical brightening agent 351) (Smart, 1984). Straight-line distances traced ranged from 1,500 feet (457 m) to 28,000 feet (8,534 m). The Fluorescein and Tinopal were introduced into swallow holes as dry powder, while the Direct Yellow was mixed with water in the field, and the Rhodamine was poured in as a concentrated solution. The Direct Yellow used was 20 percent active ingredient by weight, the Rhodamine a 20 percent solution, and the other tracers were 100 percent active ingredient. Springs were monitored for dye emergence with packets of activated carbon charcoal and bleached cotton broadcloth ribbons (bow ties) attached to concrete anchors (Currens, 1993). The dye was released from the charcoal with a solution of ammonia hydroxide, water, and 1-propanol. Inspection of the elutant and cotton bow ties (or "bugs") was done visually using an ultraviolet lamp. Weak positive traces from Rhodamine or Fluorescein were confirmed using a Turner Designs[1] model 10 filter fluorometer. Quantitative dye traces are underway, but only one was completed in time for this report.

Monitoring Equipment

Monitoring equipment installed at Pleasant Grove Spring between May 20 and June 3, 1992, continuously records the quality of the discharge at 10-minute intervals (Fig. 4). A Yellow Springs Instruments (YSI) model 3800 water-quality logger records water temperature, pH, conductivity, dissolved oxygen, turbidity, and barometric pressure. The YSI also records a point-discharge velocity from a Marsh-McBirney 201-D water flow meter. A Telog Water Level Recorder (model 2109) independently records the stage. A portable ISCO automatic water sampler has also been installed to collect storm samples. A model 2900 ISCO is used to collect samples at closely spaced, regular intervals, generally 12 hours. The monitoring equipment at each of the upstream sites includes a staff gage and Telog Model 2109e water-level recorder. Battery-powered ISCO samplers are temporarily installed as needed. All of the Telog data loggers are battery powered. The YSI 3800 and Marsh-McBirney 201-D are normally powered by commercial line power, but have battery backup. The ISCO's at Pleasant Grove Spring may be powered by either batteries or line power.

A simple weather station was also installed at Pleasant Grove Spring. A Telog model 2107 pulse recorder records from a Rain Wise tipping bucket gage, and a Telog model 2103 ambient temperature recorder records the air temperature. A non-recording rain gage is used as a check on the tipping bucket. Both loggers record at 10-minute intervals.

The record from all water-level recorders is nearly 100 percent complete. The overall record from the YSI 3800 is approximately 79 percent complete due to power outages, lightning strikes, and other minor malfunctions. The Marsh-McBirney velocity meter has suffered lightning damage and cable damage from objects discharging from the spring and from handling, resulting in a 60 percent complete record. The dissolved oxygen and turbidity probes have also occasionally failed or become fouled, resulting in 67 and 57 percent complete records, respectively.

Discharge Measurement

Discharge measurements were made by the partial sections method and wading (Buchanan and Somers, 1976) with a Marsh-McBirney 2000 magnetic water flow meter. Measurements were made during reconnaissance sampling to provide instantaneous discharge data to accompany analytical data. Discharge measurements continue to be made at monitoring stations to develop rating curves for continuous discharge calculation (Fig. 5). The discharge data for Pleasant Grove Spring were used to develop a rating curve by correlating stage observations with discharge (Fig. 6). The continuous stage record was then used to calculate a continuous discharge hydrograph. A similar process was also used for Leslie Page karst window. The discharge-stage relationship is controlled by the channel cross section at all stations except Upper Pleasant Grove Creek, where a box culvert supporting Johnson-Young Road controls the relationship. In June 1994 beavers built a dam on Upper Pleasant Grove Creek a few hundred feet downstream of the box culvert, which changed the control of the stage-discharge relationship. This situation requires replacement of the earlier discharge and stage observations, but work has not yet begun. Because the George Delaney swallow hole site is normally dry, the collection of sufficient discharge data to devel-

[1] The use of manufacturer and trademark names does not constitute an endorsement of the product by KGS or the University of Kentucky; these names are included for reference only.

Figure 4. View of Pleasant Grove Spring showing instrumentation in the spring mouth supported by a pier; storage shed housing data loggers and other equipment is in the background.

Figure 5. Discharge measurements being made at Pleasant Grove Spring during the May 1993 high-flow event.

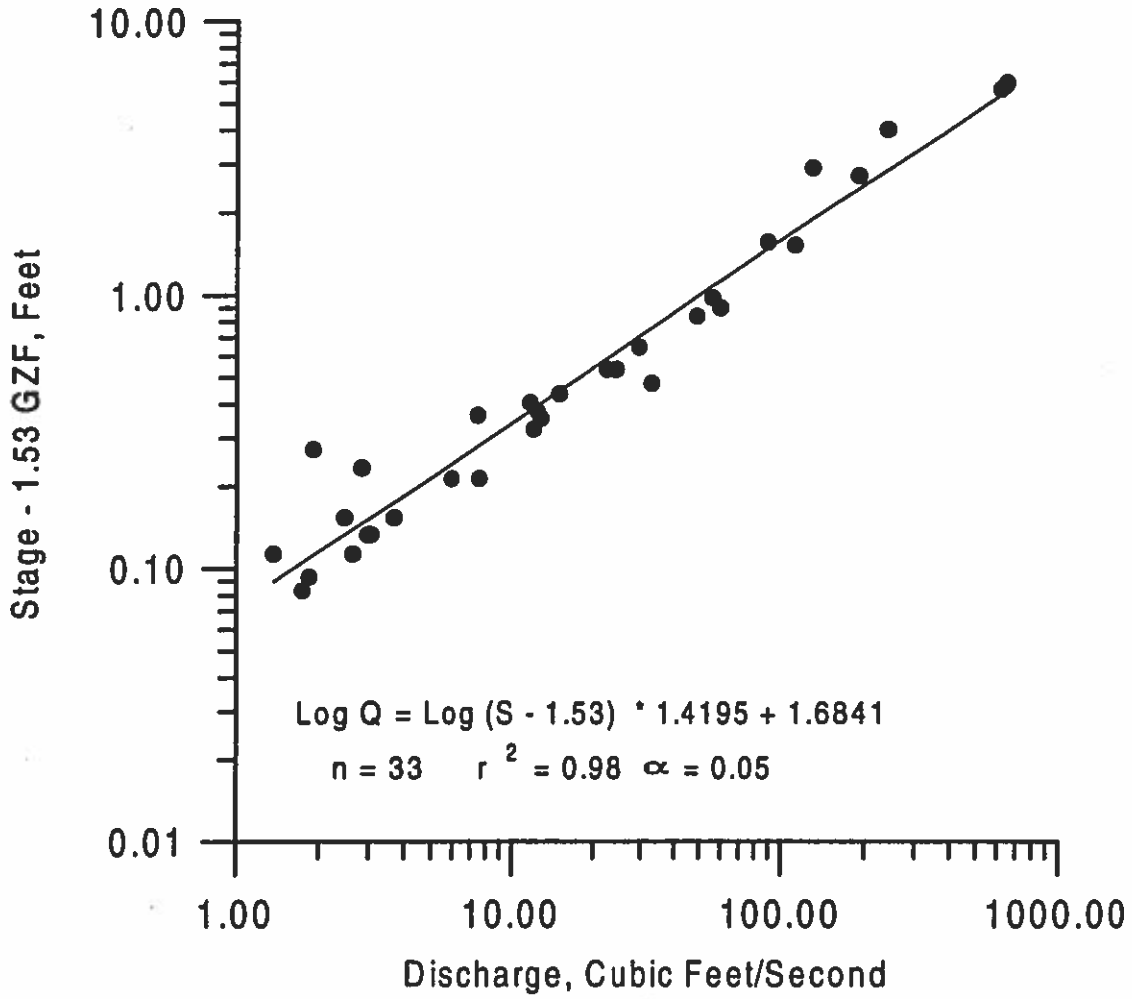

Figure 6. Stage versus discharge rating curve for Pleasant Grove Spring.

op a rating curve has been delayed. Discharge measurements are reported in Appendix A.

Sample-Collection Methods

Water samples were collected using field protocols and quality-control practices of the U.S. Geological Survey (1982) and the U.S. Environmental Protection Agency (1983). All samples collected by dipping were with the mouth of the bottle facing upstream (ASTM D3370). All sample containers were new, and intermediate containers were not used. Samples from domestic wells in use were collected at the faucet nearest to the well, directly into the sample container. Samples from abandoned wells were collected with a bailer decontaminated as described below. For the reconnaissance samples and other samples collected for comprehensive analysis, conductivity, pH, and temperature were measured in the field, and pH and conductivity were also measured in the laboratory. Because of the logistical constraints imposed by the simultaneous collection of bacteria samples and discharge data, only samples for total analysis were collected during the reconnaissance sampling.

All sampling equipment was cleaned in compliance with EPA method 507 (revision 2.0, paragraph 4.1.1) (U.S. EPA, 1989). The equipment was washed with tap water and laboratory detergent, rinsed with tap water, rinsed three times with distilled water, and final-rinsed with reagent-grade acetone instead of oven drying. Sample containers and preservation methods are detailed in Appendix B.

The collection of samples for dissolved constituents, including pesticides, was begun in October 1993 for samples collected at Pleasant Grove Spring. These samples were collected with a peristaltic pump directly from the rise pool of the spring; intermediate containers were not used. Samples were pumped through a stainless steel and Teflon filter stand equipped with Teflon tubing. The stand and tubing were assembled and sealed immediately after cleaning for later transport to the field.

High-flow event samples were collected by an ISCO 3700 automatic sampler directly from the rise pool of the spring. The ISCO and its sample containers were decontaminated before each field deployment, according to EPA method 507. The intake tubing and screen were assembled and sealed for transport immediately after cleaning. Upon installation, each ISCO sampler was purged with water from the sample site, and intake lines were left empty. The samplers were activated by a water-presence sensor. When activated, the sampler is programmed to fill and purge the intake lines three times before filling the sample container.

Rainwater samples were collected for pesticide and nitrate analysis using a ring stand and glass funnels deployed away from trees and buildings. An 8-inch-diameter glass funnel emptied into a 4-inch-diameter funnel covered with a stainless-steel screen. The spout of the smaller funnel fit tightly into the mouth of a sample bottle.

Sampling Schedule

Comprehensive, reconnaissance samples were collected monthly at six sites. These sites are Pleasant Grove Spring (PGSP), Spring Valley karst window (SVKW), George Delaney swallow hole (GDSW), Shackelford Spring (SKSP), The Canyon karst window (TCKW), and Flowers estavelle (Thad Flowers bluehole [TFBH]). During some months, sites were not sampled because the site was dry or because ponding from flooding prevented access to moving water. Samples were not collected on other occasions because of holiday schedules at laboratories and other logistical issues. During the no-cost extension periods between project phases (April 1993–September 1993 and September 1994–March 1995) sampling schedules were modified to minimize cost.

Additional samples were collected more frequently than the monthly comprehensive samples. Base-flow samples were collected during low-flow conditions on a schedule that varied from biweekly in the spring to monthly in the late summer, fall, and winter. Event samples, which were also analyzed for total suspended solids and total dissolved solids, were collected during high flow, initially every 20 minutes, then over incrementally longer time periods as the stage receded. An attempt was made to collect a suite of event samples for every storm causing a 0.1 foot (3 cm) or greater rise in stage at PGSP from mid-March to July. Samples for bacteria, ammonia, nitrite, and orthophosphate were not collected for storm events because samples had to be left in the ISCO samplers for periods exceeding the holding times recommended for these constituents. Failure of the ISCO samplers due to power outages, premature activation of the sampler, and flooding of the sampler caused some high-flow events to be missed. Stage response at Leslie Page karst window (LPKW) was frequently so minor that the sampler failed to detect the rise in stage and the samples were not collected. This sampler was reprogrammed to collect samples every 12 hours.

Rainwater samples were collected in May and June of 1992, 1993, and 1994. Deployment periods for the rain sampler were as long as a month, but most were for specific storms and were retrieved within 12 hours. Samples were collected from domestic wells on an ad-

hoc basis. Comprehensive samples were collected monthly during the spring, and quarterly the remainder of the year from Pleasant Grove Spring and Leslie Page karst window. The logistical constraints imposed by the relatively short holding time for bacteria resulted in a hiatus in bacteria sampling from May 1992 to March 1994.

Analytical Methods and Quality Control

All major-ion and pesticide analyses were performed at the Kentucky Geological Survey's Water-Quality Laboratory. Comprehensive samples were analyzed for major ions, nutrients, and pesticides. Event samples were analyzed for nitrate, total dissolved solids, total suspended solids, and pesticides by enzyme-linked immunosorbent assay (ELISA). Base-flow samples were analyzed for nitrate and pesticides by ELISA. Precipitation samples were analyzed by gas chromatography (GC) or ELISA, depending on available sample volume. Cations were determined on an inductively coupled plasma spectrometer, and anions were determined on an ion chromatograph. Pesticide analyses were made on a gas chromatograph using EPA methods 507 and 508. The Ogden Environmental Laboratory at Western Kentucky University in Bowling Green conducted bacterial determinations. Bacteria counts were determined by multiple-tube fermentation and most-probable-number statistical estimation. Volatile organic compounds were determined by the water-quality laboratory at Heidelberg College, Tiffin, Ohio. See Appendix B for a complete list of analytical methods and discussion of the ELISA method.

Conductivity and pH meters were checked for proper operation before each field trip. Meters were calibrated or compared with standards at the beginning of each sampling day. Permanently installed water-quality meters were calibrated monthly. The Marsh-McBirney flow meters are factory calibrated and cannot be adjusted in the field. All monitoring equipment is cleaned and checked monthly to ensure proper operation.

Quality-control samples included equipment blanks, trip blanks, and field blanks. Pesticide analyses were made in replicate by the laboratory as part of its internal quality assurance. Duplicate samples for nitrate and pesticide analysis were collected from Pleasant Grove Spring monthly beginning in 1994.

Quantification of ELISA

Pesticide analysis by ELISA was chosen because the number of analyses needed for mass-flux estimation was cost prohibitive and logistically impractical by gas chromatograph. The validity of quantifying pesticide concentrations with ELISA was evaluated by analyzing split samples by GC and ELISA for triazines, alachlor, and metolachlor. Other pesticides for which ELISA kits were available were not compared because GC methods for carbofuran and 2,4-D were not available. Work underway at KGS shows that alachlor by ELISA correlates poorly with GC determination. However, for 29 ground-water samples with GC atrazine concentrations equal to or above the GC detection limit (0.3 µg/L), the correlation coefficient (R^2) was 0.93 for ELISA triazines versus GC atrazine (Fig. 7). The detection limit for triazines by ELISA was 0.046 µg/L. Another correlation was calculated for samples with both GC atrazine and ELISA concentrations below 1 µg/L and equal to or above 0.3 µg/L. While the correlation was not as good as when higher concentrations were included (R^2=0.91), it still suggests that the ELISA method for triazines can be used quantitatively for atrazine at concentrations above 0.3 µg/L, but may be valid only as a presence-absence test below that concentration. Thurman and others (1990) found a correlation of 0.99 for ground water spiked with atrazine. Nearly all samples analyzed by GC have shown below-detection concentrations of cyanazine and simazine, and the manufacturer of the ELISA kits (Ohmicron, 1991) reported that low levels of cyanazine and simazine are largely undetected by the triazine kit. The correlation coefficient for 19 metolachlor samples with concentrations ranging from a GC detection limit of 0.05 µg/L to 8 µg/L was 0.80 (Fig. 8). These results suggest that the ELISA method can be used quantitatively for atrazine and metolachlor. Error bars are not shown on concentration graphs because they obscure the location of data points. Standard deviation for laboratory replicates of atrazine is 0.063 at 1.0 µg/L and 0.13 for metolachlor at 1.30 µg/L.

Mass-Flux Calculation

The mass flux of agriculture-related chemicals discharging from Pleasant Grove Spring was estimated by multiplying the volume of water discharging during a 10-minute interval by the concentration of monitored constituents in the most recent sample, and summing the 10-minute interval flux values between samples. Nitrate-nitrogen concentrations were used directly. An equivalent atrazine concentration was calculated from triazine determinations using the regression of triazines by ELISA and GC-determined atrazine. A metolachlor equivalent flux was estimated in the same way. Flux for suspended sediment has not been estimated because of fouling and failure of the turbidity probe. A

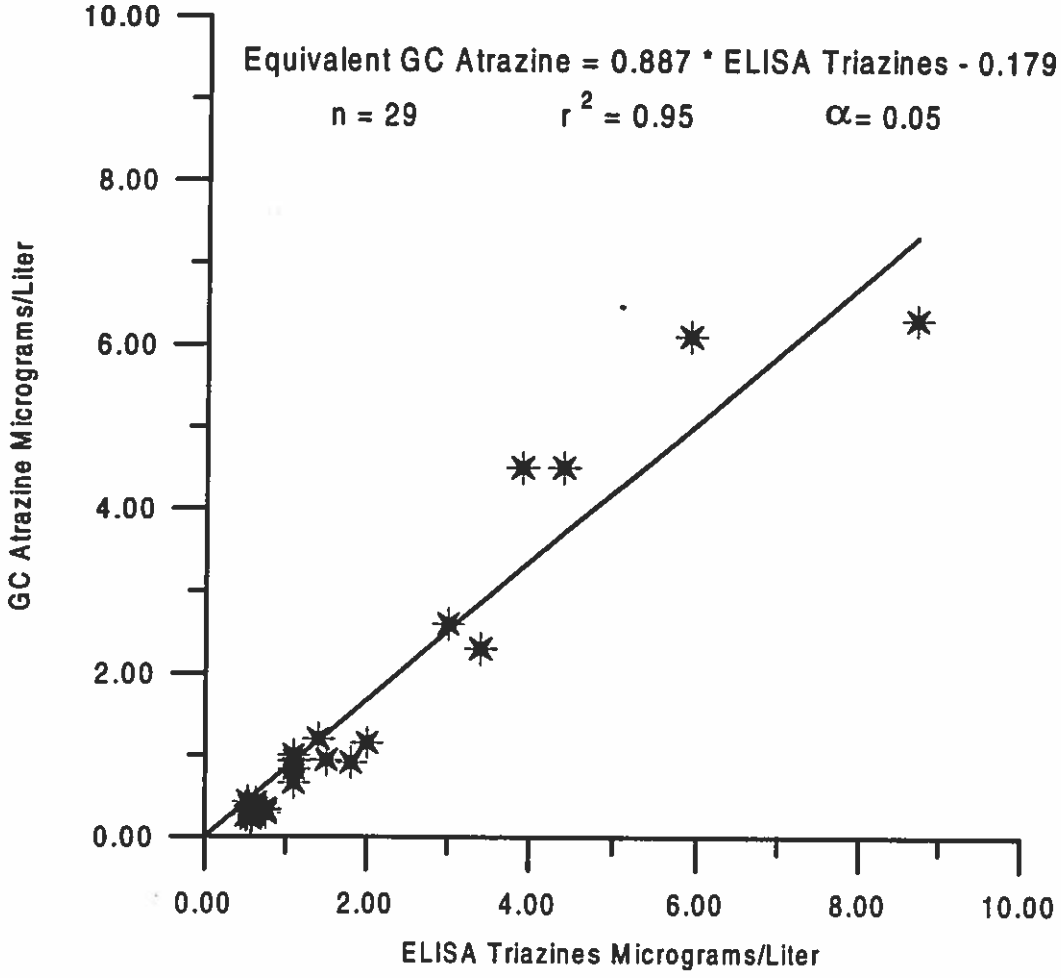

Figure 7. Cross plot of triazine determinations by ELISA (immunoassay) versus atrazine by gas chromatography (GC).

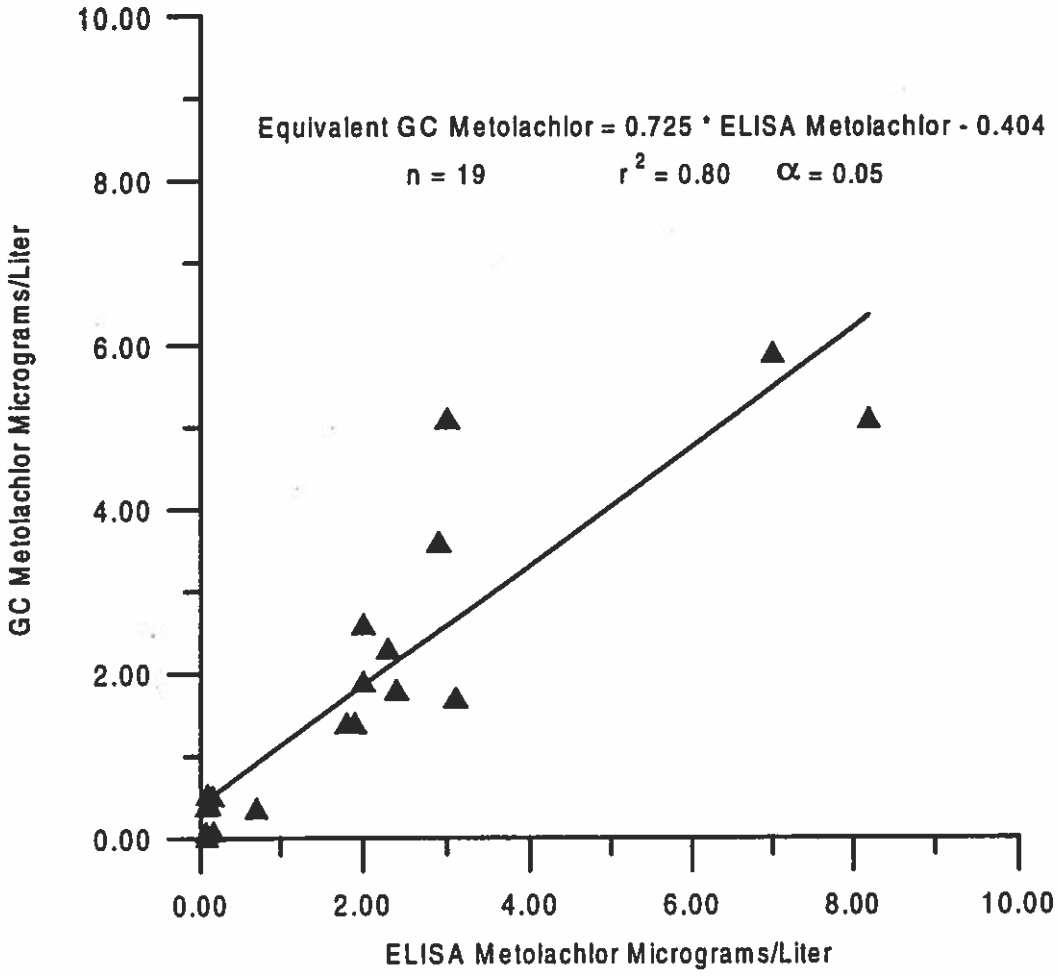

Figure 8. Cross plot of GC metolachlor and ELISA metolachlor.

flux for alachlor was not estimated because of the poor correlation between GC and ELISA. A carbofuran flux was estimated using ELISA analyses, but its significance is unknown because there was no GC method for carbofuran available at KGS.

Land-Use Mapping

A generalized land-use assessment (Plate 1) was prepared by Mr. Bill Johnson and his staff at the Logan County Soil Conservation Service (now Natural Resources Conservation Service), U.S. Department of Agriculture. Total annual crop areas for 1991 through 1994 were measured by planimeter from maps prepared by the Kentucky Geological Survey from aerial photographs taken for the Agricultural Stabilization and Conservation Service, USDA.

DISCUSSION OF RESULTS

Land-Use Mapping

Land-use mapping shows nearly 70 percent of the basin is crop land and another 22 percent is pasture. Between 3,000 and 3,700 acres (1,200 and 1,500 hectares) of corn are grown annually. Industrial activity is absent from the basin; the only non-agricultural business is a small tractor and automobile repair garage. There is no urban development, and suburban development is limited to roughly 30 homes in the rural community of Oakville, and scattered farm housing. No rail lines and only one state highway cross the basin, and there is little industrial traffic. There is no active petroleum production in the basin, and a review of the Oil and Gas Well Record Data Base at the Kentucky Geological Survey revealed very limited historical activity.

Precipitation Analyses

Of seven rain samples collected, only a few contained measurable amounts of pesticides (Appendix C). A sample collected from June 17 to July 7, 1992, contained 2.8 µg/L of butylate, but triazines, atrazine, and carbofuran were not detected. Concentrations of alachlor and metolachlor did not exceed 0.18 µg/L by ELISA. This sample is suspected to have been contaminated by an insect. The greatest concentration of triazine was from a sample collected between May 19 and June 1, 1993 (0.93 µg/L). Another sample collected between 16:00 May 18 and 08:55 May 19, 1993, contained 0.68 µg/L triazine. These data may reflect dusty conditions caused by the unusually dry weather in the spring of 1993. Triazine concentrations averaged 0.49 mg/L. Nitrate-nitrogen was also determined for three samples collected in 1993 and 1994, and all measured less than 1 mg/L.

Hydrogeology

Ground-Water Basin Boundary Mapping

Forty-seven ground-water dye traces were conducted through March 1994 and are summarized in Appendix D. The watershed boundary was defined, and the area of the basin is now estimated to cover 10,291 acres (4,165 ha). Plate 2 illustrates the basin boundary, the location of major karst features, and ground-water dye-trace vectors. The ground-water basin boundary is roughly consistent with the apparent topographic divide, except in the vicinity of Oakville, where sinkholes are closely spaced.

In addition to identifying the basin boundary, the dye tracing resulted in other findings that are significant to understanding the hydrogeology of the basin. The Canyon karst window was initially chosen as a potential monitoring station of a hypothesized small subbasin. Dye introduced into Piper estavelle, while it was acting as a swallow hole, was detected at The Canyon karst window. This trace and traces from Miller sinkhole and Harper karst window revealed that The Canyon karst window has a significant catchment area.

Outside of the northwest boundary of the basin, sinkholes east of Miles karst window encroach on Upper Pleasant Grove Creek. According to area residents, much of the area north of Johnson-Young Road was marshy before drainage was channelized. The rim of the sinkhole nearest the now-channelized Upper Pleasant Grove Creek lies less than 10 feet (3 m) above the normal stage of the creek and within 200 feet (60 m) of the channel. Water from Upper Pleasant Grove Creek may spill into the sinkhole during extreme high flow, although this has not been observed by KGS personnel. Dye introduced into this normally dry sinkhole was detected at Hickory Hill karst window and Dawson Spring, outside of the Pleasant Grove Basin (Plate 2). To determine if flow from Upper Pleasant Grove Creek was diverted outside the basin, 2 liters of Rhodamine WT were introduced at dusk into Upper Pleasant Grove Creek, during moderate flow, in the vicinity of Green Downs Road. Although all known springs along Whippoorwill Creek were monitored, dye was only detected at Pleasant Grove Spring, indicating no leakage during moderate or lower flows.

Each year Piper estavelle acts as a spring from November through May, and the combined flow from it, Shackelford Spring, and Upper Pleasant Grove Creek continues south to George Delaney swallow hole. South of George Delaney swallow hole the now-abandoned channel of a surface-flowing Pleasant Grove Creek is dry except during high flow. Johnson swallow hole, at the southern end of the abandoned channel, re-

ceives flow when the intake capacity of George Delaney swallow hole is exceeded. Flow into Johnson swallow hole was traced to Pleasant Grove Spring. However, during extremely high flow the inflow capacity of Johnson swallow hole is also exceeded, and water discharges overland to Pleasant Grove Creek, downstream of Pleasant Grove Spring. Johnson swallow hole, George Delaney swallow hole, and Piper estavelle, along with numerous minor swallow holes, form a headward-retreating series of swallow holes diverting the surface reaches of Upper Pleasant Grove Creek underground to Pleasant Grove Spring.

Only one quantitative trace has been completed. Because this trace was the first trial to determine a rough travel time, no attempt was made to estimate the centroid of the breakthrough curve or calculate the dye recovery. Rhodamine WT (500 ml, 20 percent solution) was introduced into George Delaney swallow hole under low-flow condition (PGSP discharge 3.3 cfs [0.1 cms]). Dye was detected 23:40 hours after injection, and concentrations peaked after 25:50 hours. Straight-line flow velocity under these conditions is roughly 0.14 ft./sec. (0.04 m/sec.) but is expected to be much faster under high-flow conditions.

Plate 2 shows the location of King sinkhole, but with no trace vectors leading from it. Four attempts were made to trace from this sinkhole, without success. Because the trace was deemed lower priority than others being conducted at the same time, Tinopal CBS-X was used for the first three attempts. Also, earlier in the dye-tracing program a trace was lost from a poorly draining sinkhole approximately 1,000 feet (300 m) southeast of King sinkhole. After these traces were lost a second boat reconnaissance was made on Whippoorwill Creek to seek a missed spring. Although some suspicious channel reaches were noted, no new springs were found. A fourth trace was attempted from King sinkhole using Fluorescein, but it also failed despite over 25 springs and bridge crossing being monitored. Although no field evidence could be found suggesting a hidden spring, the lost traces are thought to have flowed to Whippoorwill Creek. The missing spring may rise in mid-channel of Whippoorwill Creek between Burchette Spring and Claude Blick Spring. None of the traces flowed to Pleasant Grove Spring.

To supplement the ground-water dye-trace data, a potentiometric map of the study area was prepared (Plate 3). Between June and September of 1993 over 100 domestic wells were inventoried (Appendix E), and 30 water levels were obtained (Cupp, 1994). The sparse number of water-level observations made the placement of some potentiometric contours subjective. In general, contours in the headwaters area are more widely spaced, although wide spacing can be found in the conduit flow area. The area between George Delaney swallow hole and Johnson swallow hole is problematical; the potentiometric surface and the positioning of flow routes are open to alternative interpretation. The dye trace from Johnson swallow hole did not travel through Spring Valley karst window, but the location of the confluence of its conduit with the conduit from SVKW to Pleasant Grove Spring is subjective. The confluence may be much closer to Pleasant Grove Spring, and the flow route nearly parallel to the relic valley from Johnson swallow hole to Pleasant Grove Creek. In this case, the 510 foot (155 m) potentiometric contour along the flow route from GDSW to Pleasant Grove Spring would be more constrained to the vicinity of the conduit. A second, narrow potentiometric low would extend from just south of GDSW, south to Johnson swallow hole, then to Pleasant Grove Spring. However, the watershed boundary between Johnson swallow hole and Pleasant Grove Spring would remain unchanged because field inspection of the topography verifies that runoff from this area must bypass Pleasant Grove Spring.

Ground-Water Flow Regimes

An area in the northern, headwater, portion of the basin was found to be characterized by slower flow rates than in the southern portion (Plate 3). Although karstic, the area exhibits characteristics suggestive of a more diffuse, slow-flow regime. The gradient of the potentiometric surface in the headwater area is slightly more gradual than in the conduit, fast-flow-dominated area. Dye-trace travel times in this area were less than 0.005 ft./sec. (0.002 m/sec.). The water table in the slow-flow area is near ground level, as evidenced by marshes, common sinkhole ponds, and "blueholes" (local name for shallow sinkholes intersecting the water table, many of which function as estavelles). Wells in the area encounter water at shallow depths, typically less than 30 feet (9 m). Springs in this area are relatively small (with flow rates ranging from 0.5 to a peak of 5 cubic feet per second [0.05 to 0.5 m^3/sec.]) and empty into surface drainage that sinks again as flow approaches the southern end of the basin.

Ground water in the southern part of the basin flows rapidly through large, efficient caves. Qualitative dye-trace travel times exceed 0.02 ft./sec. (0.006 m/sec.), indicating substantially higher underground-stream flow velocities than in the slow-flow area of the watershed. Springs in the conduit, fast-flow regime have significant increases in discharge and become turbid within a few hours of a major storm. Flow rates at Pleasant Grove Spring range from as little as 1.5 cubic feet

per second (42 L/sec.) during base flow to several hundred cubic feet per second (thousands of liters per second) during a major storm. Water-quality data supporting this hypothesis are presented below under the heading "General Ground-Water Characteristics."

The slow (diffuse) flow regime is thought to be a result of a shallower hydraulic gradient. Low gradients in carbonate aquifers lead to relatively uniform dissolution along many joints and bedding planes, rather than concentrated solution along a headward-migrating conduit. The lower gradient could be caused by either or both of two hydrologic factors. First, the slow-flow area could be less maturely karstified because insufficient time has elapsed since Pleasant Grove Spring developed for headward progression of conduits to reach the area. However, because karst development in the Pennyroyal Region has been in progress for as long as 10 million years (Palmer, 1981), a lack of sufficient time seems unlikely. Second, an insoluble cherty zone could be retarding conduit enlargement along its outcrop. Flow to the south would be inhibited as it passes through constricted solutional openings in the carbonate rock between nodules of the nearly insoluble chert barrier. Numerous small springs emerge above this horizon, and streams sink a few hundred feet down section of its outcrop. The retarding horizon may be an unnamed chert horizon, or the Lost River Chert.

Several features in the basin function as estavelles. An estavelle functions as a swallow hole when the water table is low. Quick runoff from storms sinks into the feature until the water table rises to the elevation of the estavelle. When the water table rises higher during prolonged rains in the winter and spring, the estavelle acts as a spring. Piper estavelle, Thad Flowers bluehole or estavelle (TFBH), and Wheatfield estavelle have all changed function from springs to swallow holes sometime during the study period. Many unnamed karst features in the study area also act as estavelles. Locally, both rise-pool springs and estavelles are called "blueholes" (Thad Flowers bluehole, for example). Water ponds in the outlet of Thad Flowers bluehole when the water table is too low for the feature to discharge but high enough to submerge the outlet. Similar conditions apply to Harpers well, which discharges or accepts inflow depending on ground-water stage. Harpers well is a sinkhole into a cave that has been enlarged and lined with masonry to serve as a well.

The alignment of sinkholes, the bearing of ground-water dye-trace vectors, and the orientation of passages in mapped caves (Mylroie, 1984) suggest ground water flows along the local strike until it reaches a breach in a resistant bed. At this point flow changes direction toward the Red River, local base level. Because the regional strike trends northeast-southwest and the Red River is due south of the basin, a trellised drainage pattern has developed.

Ground-Water Quality

Sampling

During Phase I, reconnaissance synoptic, comprehensive samples were collected monthly at six sites across the basin (Plate 2). These sites are Pleasant Grove Spring, Spring Valley karst window, George Delaney swallow hole, Shackelford Spring, The Canyon karst window, and Thad Flowers bluehole (estavelle). During Phase II, regular sampling continued at Pleasant Grove Spring and included monthly comprehensive samples, base-flow samples, and event samples. Base-flow samples were also collected at George Delaney swallow hole. In the spring of 1993 Leslie Page karst window was added as a monitoring site to replace The Canyon karst window as a small sub-basin. Sampling at LPKW included quarterly comprehensive, base-flow, and event samples. Also at this time the Upper Pleasant Grove Creek (UPGC) monitoring station, 2,500 feet (760 m) downstream of Shackelford Spring, replaced SKSP as a monitoring site. Shackelford Spring was abandoned because the spring was in a remote location, its discharge was difficult to measure accurately, the site was a poor location for a continuous stage recorder, and the owner was reluctant to continue to allow access. The Upper Pleasant Grove Creek site is on the public right of way and has the benefit of a bridge to control discharge. Also, while SKSP represents ground water from the headwaters area, UPGC represents the overall quality and quantity of discharge from the entire area.

Finally, an abandoned domestic well called Miller School House well (MSHW) (Kentucky Division of Water identification number AKGW-17158), on the east-central margin of the basin near Oakville, was added as a control sampling point that was unlikely to intercept any agriculutral chemicals. The well is cased with steel from ground level to the top of bedrock and is approximately 84 feet (25.6 m) deep. The only protection from surface contamination is a limestone slab over the hole.

In order to develop a consistent format for future reports, the data in this report are presented as water year (October 1 through September 30) annual summaries. Descriptive statistics summaries for each year are presented in the appendices, but their significance as characteristic of the ground-water quality should be considered with caution. The effects of "aliasing" (the phenomenon in which a high-frequency trend can be

interpreted as a low-frequency trend because the sampling was too infrequent to characterize the low-frequency trend) and variable temporal spacing of samples has a major impact on the representative validity of the statistics. Table 2 summarizes standards for drinking water, which are commonly used as criteria for evaluating the quality of ground water.

General Ground-Water Characteristics

Basinwide, ground-water temperatures average 14.5°C, typical of Pleasant Grove Spring (Appendix F). Conductivities observed in the basin range from 744 microsiemens (µS) at PGSP to only 20 µS at LPKW. The pH of water in the basin ranges from 5.9 to a slightly basic 8.5, but is commonly nearly neutral.

Table 2. Maximum contaminant levels for analyzed constituents in water samples collected from the Pleasant Grove Spring study area.

ANALYTE	*STANDARD**	*CONCENTRATION*	*FREQUENCY OR COMMENT*
INORGANICS			
Arsenic	Primary	0.05 mg/L	Annually for surface water
Barium	Primary	2.0 mg/L	Annually for surface water
Chromium	Primary	0.1 mg/L	Annually for surface water
Copper	Primary	1.3 mg/L	Variable
Lead	Primary	0.015 mg/L	Variable
Nickel	Primary	0.1 mg/L	Annually for surface water
Nitrate-N	Primary	10 mg/L	Variable
Nitrite-N	Primary	1.0 mg/L	Variable
Fluoride	Primary	4.0 mg/L	Variable
Iron	Secondary	0.3 mg/L	Annually for surface water
Manganese	Secondary	0.05 mg/L	Annually for surface water
Sulfate	Secondary	250 mg/L	Annually for surface water
Chloride	Secondary	250 mg/L	Annually for surface water
Total Dissolved Solids	Secondary	500 mg/L	Annually for surface water
Zinc	Secondary	5 mg/L	Annually for surface water
BACTERIA			
Total coliform	Primary	1 col./100 ml	1 positive sample per month or 5 percent of samples, whichever is greater
Total coliform	Supply	2,000 col./100 ml	
ORGANICS			
Alachlor	Primary	0.002 mg/L	Annually for surface water
Atrazine	Primary	0.003 mg/L	Annually for surface water
Simazine	Primary	0.004 mg/L	Annually for surface water
Carbofuran	Primary	0.04 mg/L	Annually for surface water

* The U.S. EPA water-quality standards cited are for drinking water (primary and secondary) and drinking-water supplies.

Ground water in the basin is calcium-bicarbonate type. All the sites exhibit similar chemistry (Appendix G), but Thad Flowers bluehole has some of the widest ranges in chemistry because of its alternating function as a spring and a swallow hole. Ponded water at TFBH is subject to heating and cooling, evaporation, deposition of animal feces, and oxygen loss, resulting in water quality uncharacteristic of other locations in the area. Total alkalinity ranges from an exceptionally low 37 mg/L (as $CaCO_3$) at TFBH, to a high of 241 mg/L at Pleasant Grove Spring; 180 mg/L is a typical value for the basin. Total dissolved solids never exceeded 640 mg/L and commonly measure 260 mg/L. However, total suspended solids may exceed 2,000 mg/L during high-flow events. Constituents commonly affecting ground-water quality in other regions of Kentucky are only present in dilute concentrations in the Pleasant Grove Spring Basin. The maximum total iron concentration was 7.17 mg/L at Pleasant Grove Spring and came from a highly turbid sample collected during high flow. The typical iron value for sites in the basin is 0.5 mg/L. Sulfate (SO_4) ranges from near the lower detection limit to 26.2 mg/L, and chloride has a maximum concentration of 12.8 mg/L.

Seasonal changes at Pleasant Grove and Shackelford Springs observed during reconnaissance support the dual flow-regime model indicated by dye tracing (Fig. 9). The temperature cycle at Shackelford Spring, which is thought to drain part of the diffuse-flow area, is delayed approximately 2 months compared to Pleasant Grove Spring. However, Shackelford Spring has a higher temperature in late summer, probably caused by direct solar heating of its small rise pool during low flow. Unlike temperature, the conductivity cycle is not delayed, but Shackelford Spring has a nearly constant conductivity, which narrowly ranges between 400 and 450 µS. Pleasant Grove Spring has a larger range of 136 to 744 µS. However, a Piper diagram of total analyses of major ions (Appendix H) shows no apparent difference in water chemistry (Fig. 10), which suggests the diffuse-flow area sustains base flow in the conduit-flow area.

Although contaminants are discussed at length in the next section, it is important to note at this point some differences between Pleasant Grove and Shackelford Springs. Shackelford Spring has significantly lower bacteria counts, possibly reflecting diffuse recharge. Nitrate has a significantly higher average concentration at Shackelford Spring, whereas triazines are higher at Pleasant Grove Spring. Both triazines and nitrate concentrations show less variability at Shackelford Spring than at Pleasant Grove Spring. Collectively, these characteristics support the diffuse-flow conceptual model for the catchment area of Shackelford Spring in the headwaters area of the basin.

Ground-Water Contaminants

Pesticides have been found in basin ground water in detectable quantities by both GC and ELISA (Appendix I). Atrazine (GC) and triazine (ELISA) are the most commonly detected pesticides, and are found in the highest concentrations. Only triazines and alachlor have exceeded the maximum contaminant level (MCL). The highest concentration of pesticide detected was 44.0 µg/L of triazines at Pleasant Grove Spring, May 4, 1993. A second sample collected the same day contained 28.0 µg/L atrazine (GC). These samples were collected during a major high-flow event following an extended dry period during planting season. Alachlor determined by ELISA reached concentrations as high as 12.0 µg/L during the May 1993 high-flow event. Maximum concentrations of GC alachlor, ELISA metolachlor, and ELISA carbofuran detected were 6.1, 9.6, and 7.4 µg/L, respectively. Simazine was found only on rare occasions, but once at concentrations as high as 4.5 µg/L. Butylate, trifluralin, metribuzin, malathion, endosulfan I, and endosulfan II have all been detected, but at very low concentrations (less than 0.6 µg/L). No other pesticides have been detected, although several for which KGS does not have analytical capability are used in large quantities in the basin.

The highest and most frequent pesticide detections occur from mid-March through June, after spring chemical application. Except for atrazine, concentrations above detection limit seldom occur during the fall and winter. Triazine concentrations decrease continuously during the fall and winter, reaching a minimum in February or early March. Figure 11 shows observations and triazine and nitrate analyses for Pleasant Grove Spring during Phase I. The more widely spaced temperature and conductivity data collected before May 1992 reflect discrete sampling prior to installation of monitoring equipment. Continuous monitoring began in May 1992 and produced the greater detail in the curves after that date. Precipitation data through December 1992 are daily totals from a volunteer station in Russellville, and may not reflect actual precipitation in the basin, particularly during summer months. Of note are the peaks in triazines in the spring months of 1991 and 1992 and the broad increase in nitrate during the winter, and occasional nitrate peaks after spring applications.

Nitrate-nitrogen is widespread and persistent in ground water in the basin. Application rates average 137 pounds of nitrogen per acre of crop land (154 kg/ha) annually. However, nitrate concentrations within

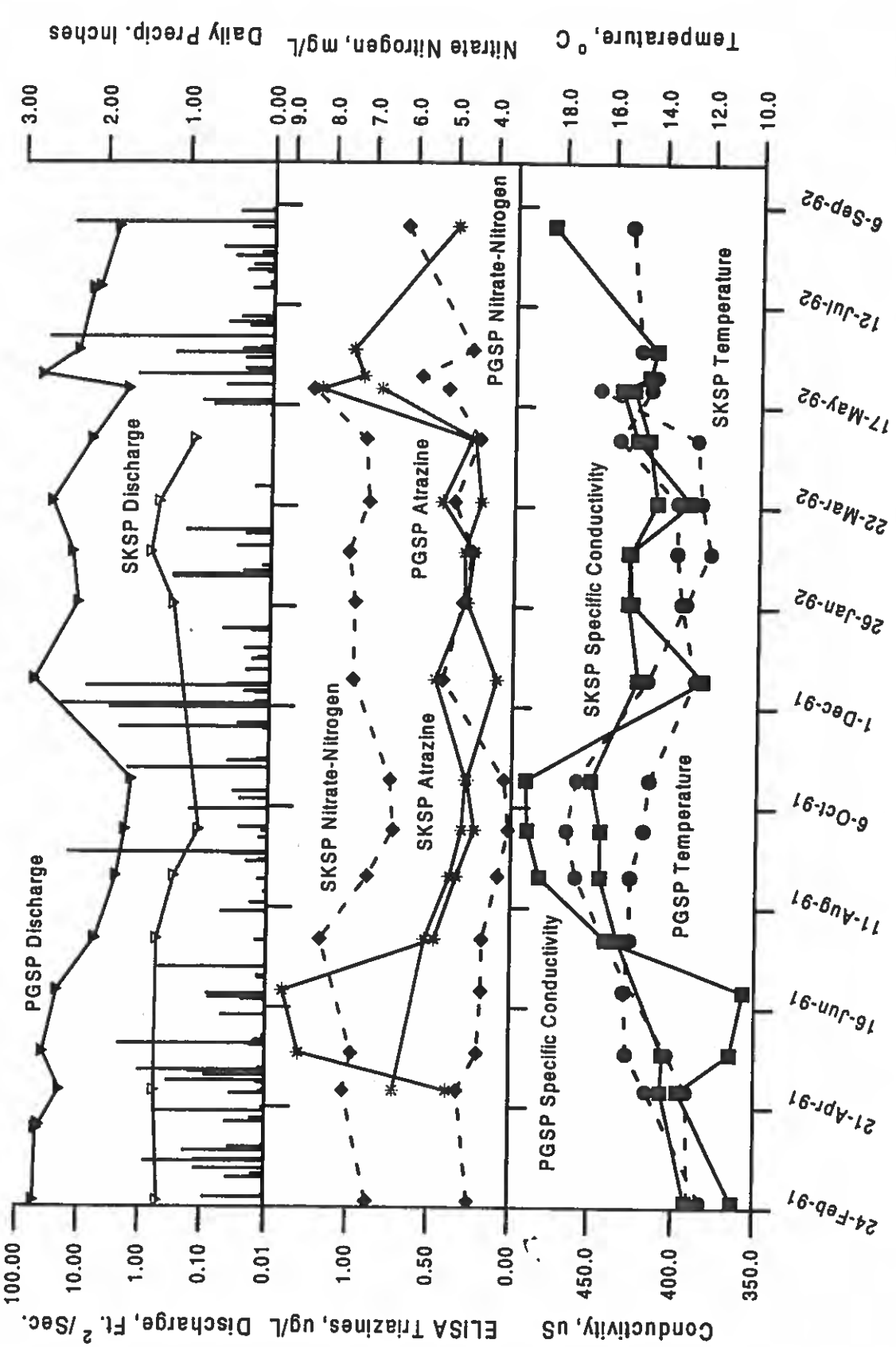

Figure 9. Chemographs and discharge hydrograph of ground water as it emerges from Pleasant Grove Spring and Shackelford Spring. Shackelford Spring drains a headwater area of the basin interpreted as having diffuse flow.

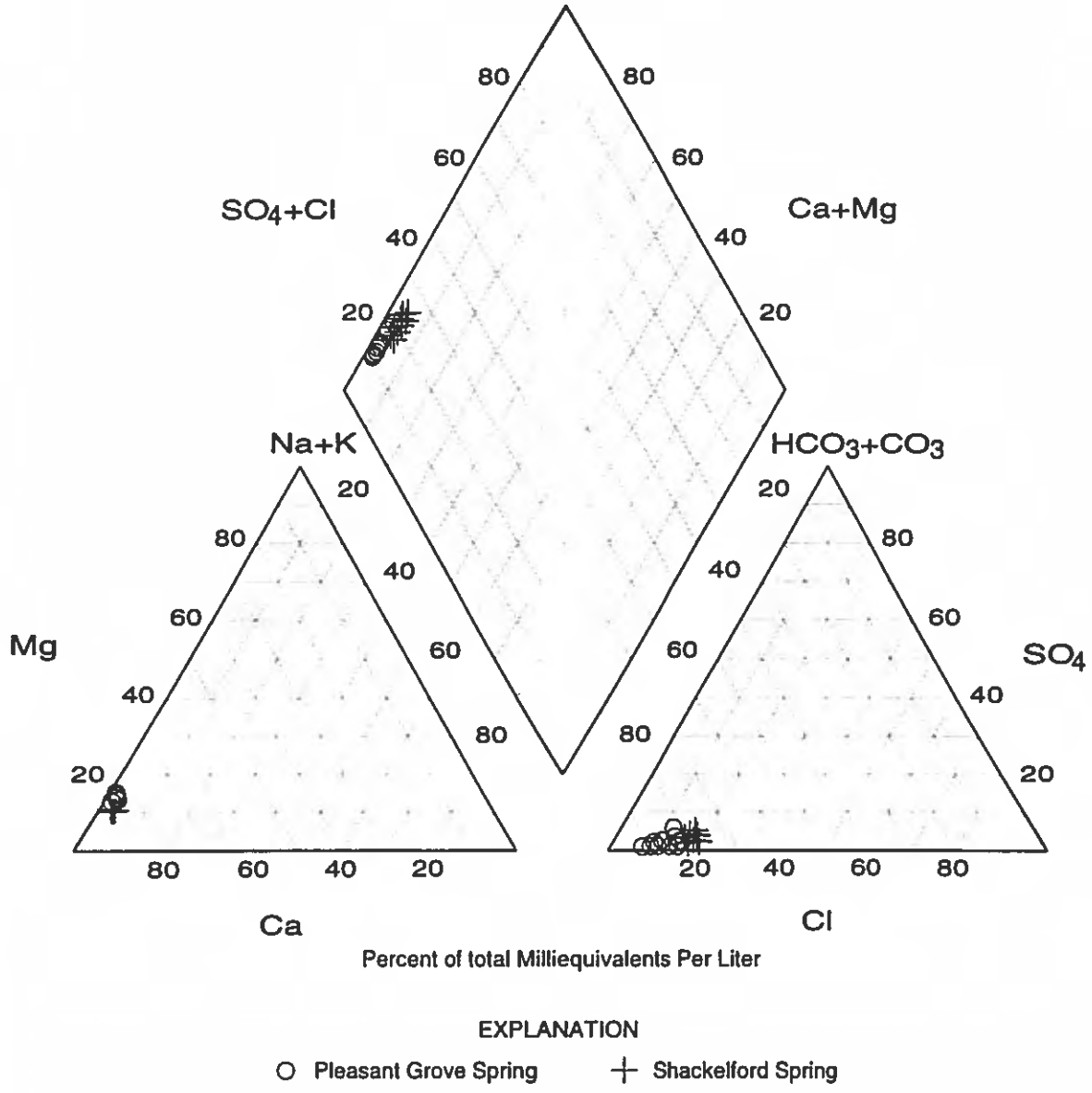

Figure 10. Piper diagram of major ionic constituents for Pleasant Grove and Shackelford Springs. All analyses are total constituents.

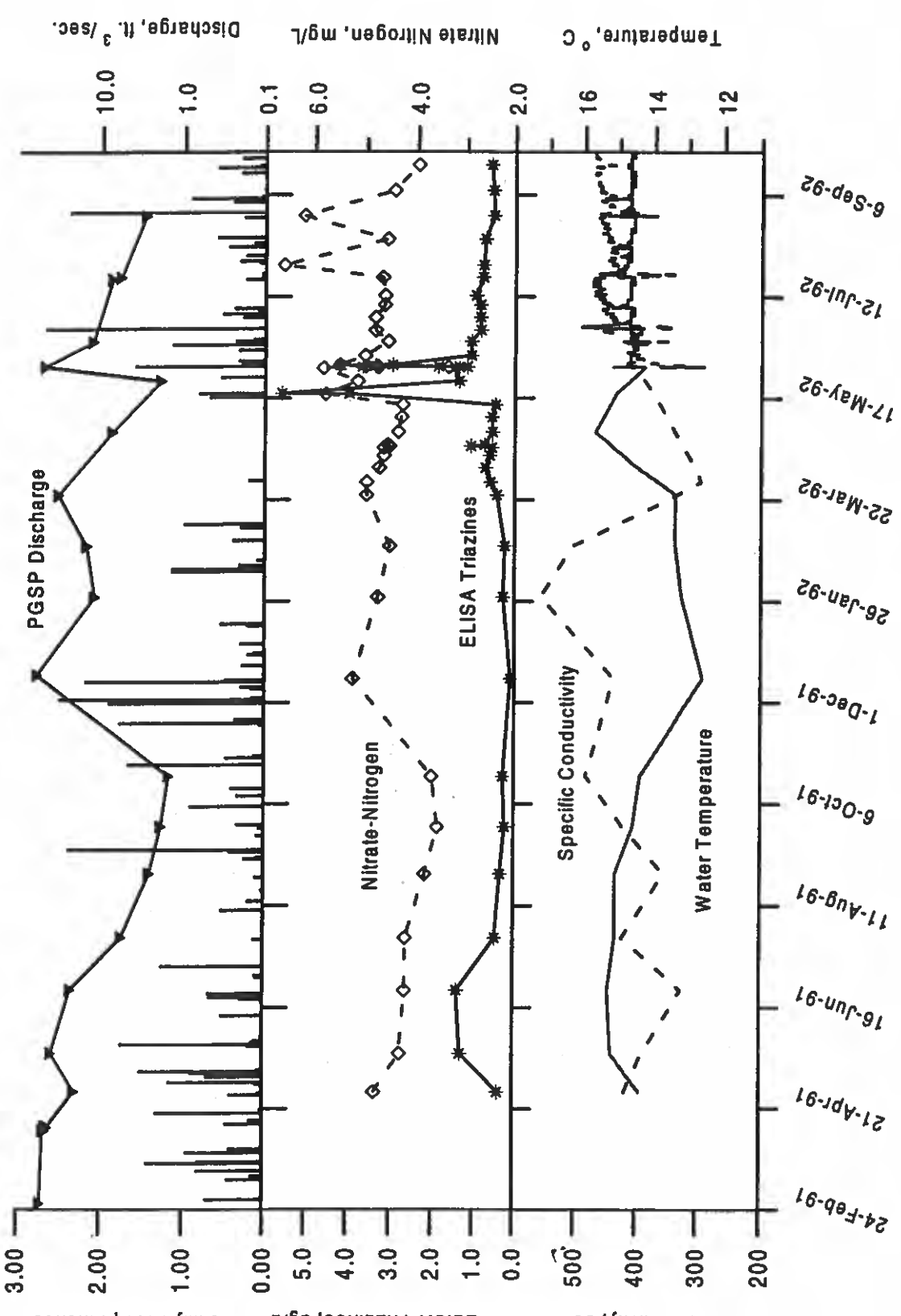

Figure 11. Discharge hydrograph, temperature, conductivity, nitrate-nitrogen, and combined GC atrazine (pre-April 1992) and ELISA triazines (post-April 1992) for the 1992-92 water year and the preceding 8 months at Pleasant Grove Spring.

the Pleasant Grove Spring Basin are typically low, only 3 to 5 mg/L. Maximum concentration for the basin to date is 10.8 mg/L nitrate-nitrogen at the UPGC sampling point in December 1993. Shackelford Spring had the highest average nitrate-nitrogen concentration during Phase I (7.3 mg/L). The highest nitrate-nitrogen concentration recorded for Pleasant Grove Spring (7.82 mg/L) also occurred in December 1993 at the recession of two closely spaced and significant rainfall events. The minimum value (2.37 mg/L) occurred April 11, 1994, during the largest discharge event gaged at the spring. Boyer and Pasquarell (1994) found average nitrate-nitrogen concentrations of 0.1 mg/L in a forested karst ground-water basin, and 0.61 mg/L in another karst basin that is 80 percent forest. Nitrite, ammonia, and orthophosphate were also determined for these samples, but have not been determined in event samples because of logistical constraints caused by limited holding time. Nitrite concentrations from samples collected at Thad Flowers bluehole from ponded water during a period of no flow never exceeded 0.43 mg/L, ammonia never exceeded 4.46 mg/L, and orthophosphate never exceeded 0.48 mg/L. Basinwide, nitrite averaged 0.03 mg/L, ammonia 0.24 mg/L, and orthophosphate 0.05 mg/L. The orthophosphate concentrations at Pleasant Grove Spring averaged 0.07 mg/L. Concentrations of 0.007 mg/L elemental phosphorous (0.021 mg/L orthophosphate) are considered natural (Verduin, 1970); higher concentrations may overstimulate the growth of aquatic plants.

Figures 12 and 13 show bacteria counts taken at Pleasant Grove Spring during Phase I and during Phase II, in March 1994. Bacteria counts always exceed the drinking-water standard (1 colony-forming unit per 100 ml) and frequently exceed the standard for water-supply sources (2,000 colony-forming units per 100 ml) by hundreds of colonies. Bacteria counts of samples collected at Pleasant Grove Spring prior to June 1992 averaged 703 fecal coliform per 100 ml, and fecal streptococci averaged 3,954 col/100 ml (Appendix J). The highest counts occurred during the late summer and late winter. Bacteria counts between March 1994 and October 1994 averaged 425 fecal coliform per 100 ml, and fecal streptococci averaged 889 col/100 ml. The highest concentrations occurred in the spring. Bacteria levels in the forested Buffalo Creek Basin in Mammoth Cave National Park averaged 85 col/100 ml fecal coliform (Joe Meiman, personal communication, 1994). Boyer and Pasquarell (1994) found mean bacteria counts of less than 1 fecal coliform per 100 ml in a pristine karst basin in southeastern West Virginia. Dr. Grant Thomas, University of Kentucky Department of Agronomy, found high fecal coliform and fecal streptococci counts, and salmonella counts from 0 to 28,000 col/100 ml at The Canyon karst window (Haszler, 1993). TCKW receives flow from both the vicinity of Oakville and areas with significant cattle concentrations. The magnitude of the salmonella counts is indicative of fecal contamination.

An animal waste-handling facility was constructed at a farm on Upper Pleasant Grove Creek between July 1992 and July 1993. The reduction in average fecal streptococci between sampling periods from 3,954 to 889 col/100 ml may be due to this facility becoming operational. Fecal coliform to fecal streptococci ratios for Pleasant Grove Spring suggest domestic sewage is the predominant source during base-flow periods, but animal waste prevails during the majority of the year. The highest counts occurred within a few days of major high-flow events. Generally, fecal streptococci were predominant in the first major high-flow event following an extended dry period, while fecal coliform were either simultaneously high or predominated in the next high-flow event.

Dr. Mark Coyne of the University of Kentucky College of Agriculture studied speciated bacteria colonies from samples collected from Pleasant Grove Spring, The Canyon karst window, Harpers well, and Leslie Page karst window in an attempt to clarify the origin of the streptococci (*Enterococcus*) bacteria. The samples were collected in April and May of 1994 and filtered and cultured by Ogden Laboratory before being mailed to the University of Kentucky. Dr. Coyne found the associations were ambiguous for domestic animal or human sources, but were coming from warm-blooded animals (Mark Coyne, personal communication, September 16, 1994). No isolates were found for *Streptococcus equinus* or *Streptococcus bovis*, indicators of horses and cattle, perhaps because these species die rapidly. A small percentage of the enterococci present are associated with wildlife. The data did suggest that the bacteria were not coming from soils or insects. Clearly, the highest Pleasant Grove Basin counts are not natural.

Optical brightening agents common in laundry detergent are frequently found in karst springs and indicate the presence of domestic sewage (Thrailkill and others, 1983; Quinlan, 1987). Additional data related to the source of the bacteria were sought by exposing cotton fabric dye detectors to flow from three springs in an attempt to measure the relative concentration of optical brighteners. Cotton fabric was mounted on frames (Thrailkill and others, 1983) and deployed in the springs for 2-week periods. The brightening agents sorb on cotton fabric and fluoresce in ultraviolet light (at wavelengths greater than 450 nm). The detectors were placed in July 1993 and July and August 1994 at

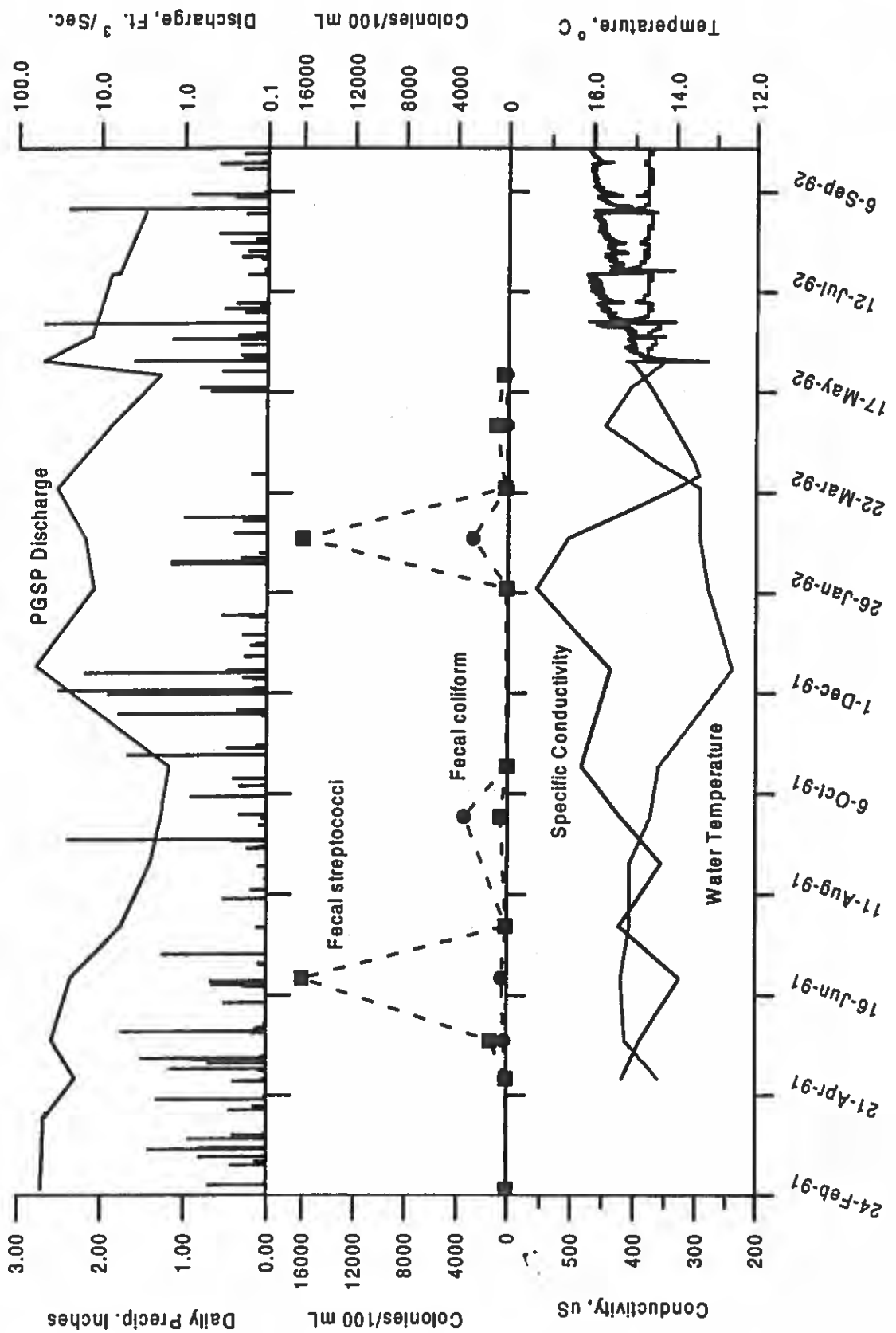

Figure 12. Line plot of Phase I bacteria counts, temperature, conductivity, and discharge for Pleasant Grove Spring.

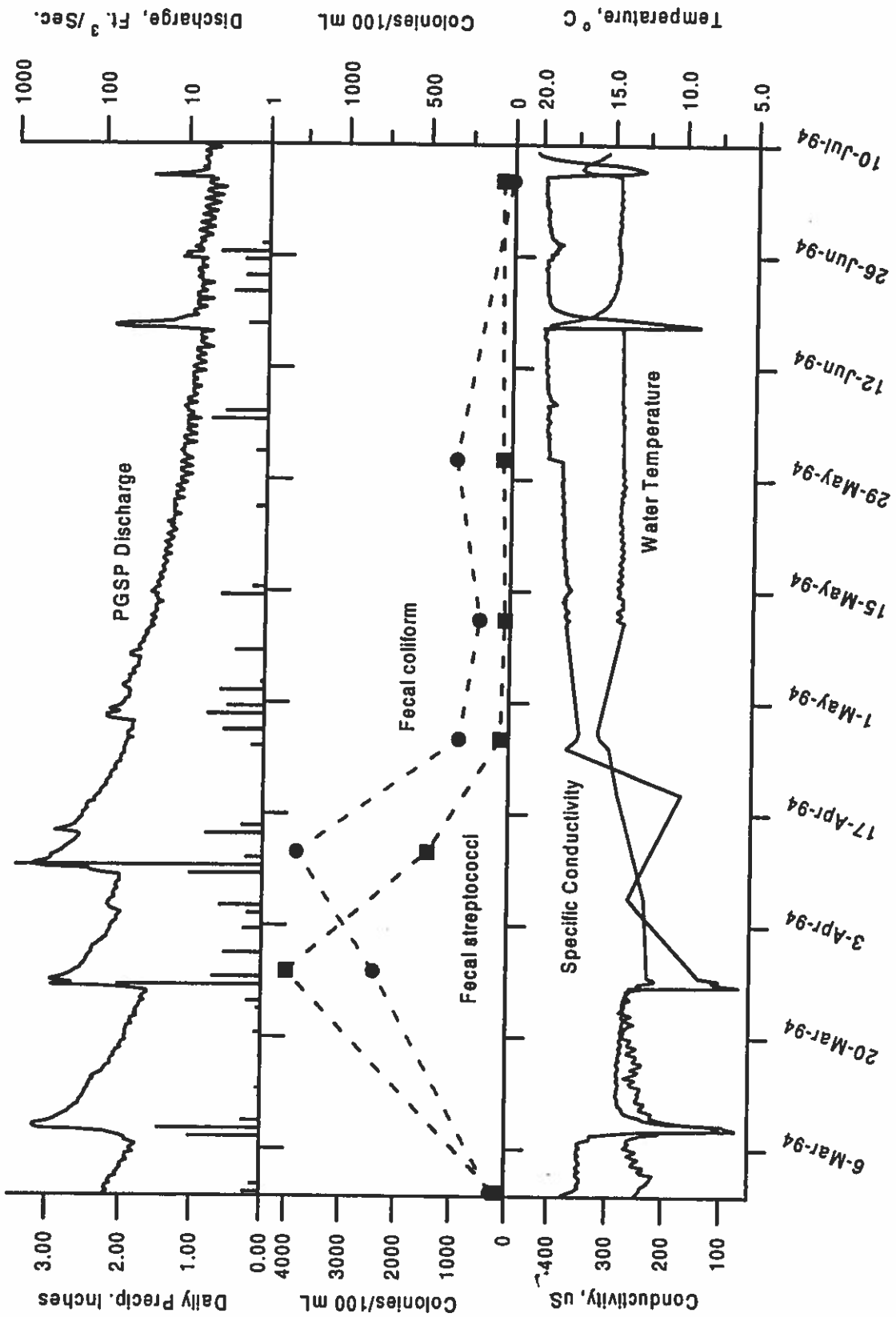

Figure 13. Line plot of bacteria counts, temperature, conductivity, and discharge for Pleasant Grove Spring beginning in March 1994.

Pleasant Grove Spring, Leslie Page karst window, and David Dotson Spring. Bacteria counts indicated that Leslie Page karst window was free of human or animal waste, while David Dotson Spring was polluted. While all three deployment periods were during base flow, modest high-flow events (less than 10.0 cfs [0.3 m^3/sec.] maximum discharge at PGSP) occurred during both of the 1994 deployments. The detectors were washed and dried and delivered to Mr. Joe Meiman (National Park Service at Mammoth Cave, Kentucky), who analyzed the detectors for fluorescence in a Shimaduzu model RF5000u scanning fluorometer. For all three deployments, no significant difference was found in the fluorescence of any of the exposed detectors and unexposed detectors prepared as controls (Joe Meiman, personal communication, 1994). The low-flow conditions prevailing during the detector deployment probably reduced the transport of brightener into ground water. Alhajjar and others (1990) found that optical brightening agents did not pass through septic system drain fields in a glacial drift setting. However, bow-tie fabric dye detectors placed in David Dotson Spring during Phase I were commonly positive for brightener, determined by visual examination with an ultraviolet lamp. In addition, a fragment of steel wool, probably from a kitchen scrubbing pad, was discovered entangled on a dye detector anchor in June 1991 at Pleasant Grove Spring. Other debris of this type have not been discovered at Pleasant Grove Spring since then.

Samples were also collected to measure volatile organics on two occasions at Pleasant Grove Spring, Leslie Page karst window, and Billy Poore Spring, which is outside the drainage basin (Plate 2). Leslie Page karst window was thought to be pristine and Billy Poore Spring possibly polluted. Analyses were performed for 59 compounds including vinyl chloride, benzene, carbon tetrachloride, styrene, toluene, xylene, and naphthalene. The samples were collected in 1993 during the May 4 high-flow event, and August 3, during base flow. Only 1,2,3 trichloropropane was above detection limits; it is an ingredient in the styrofoam packing material used to ship the samples.

Only one sample has been collected to date from Miller School House well. The sample was collected in April 1994 and was below detection for all analyzed pesticides, by both ELISA and GC. Nitrate-nitrogen concentration was only 1.45 mg/L. Although poorly constructed and in the community of Oakville, the well is relatively free of agricultural chemicals, probably because of the well's location near the basin boundary. However, samples from other domestic wells in the area (LDWW, MMWW, MHWW) have contained up to 3 µg/L triazines (Appendix C). Also, samples of treated and raw water were collected in April 1994 from the Adairville water treatment plant (CAWW), located 4 miles (6.4 km) south of Pleasant Grove Spring. Although the water plant withdraws its supply from the South Fork of Red River, and is not downstream of Pleasant Grove Spring, the flow in South Fork is maintained by other karst springs draining similar agricultural lands. Both samples of water contained over 1.0 µg/L of triazines. These data suggest agricultural chemicals are having an impact on water used for human consumption in the region.

The dual ground-water flow regimes in Pleasant Grove Spring drainage basin have significant implications for movement of contaminants in ground water. The diffuse-flow (slow-flow) regime area, which is estimated to represent slightly less than half of the basin, drains into the conduit-flow-dominated area of the basin. Contaminants in the diffuse-flow portion of the aquifer seem to persist in the ground water for many months. However, because of the quick travel time in the fast-flow regime, contaminants carried into it during storms move rapidly through the system. Also, the residual contaminants stored in the smaller conduits and epikarst are diluted and flushed out. Note the conjunction of the plots in Figure 9 of triazine concentrations for Shackelford and Pleasant Grove Springs during base-flow conditions in the late summer of 1991. This conjunction suggests the slow-flow area acted as a reservoir for contaminants, which slowly trickled out into the fast-flow part of the system, causing a background level of contamination to be maintained throughout the basin.

Annual Mass Flux of Pesticides and Nitrate at Pleasant Grove Spring

Figures 14 and 15 show precipitation and discharge hydrographs, triazines and nitrate-nitrogen concentration, and atrazine-equivalent triazines and nitrate-nitrogen flux for the 1992-93 and 1993-94 water years at Pleasant Grove Spring. The overall pattern of occurrence for triazines and nitrate from 1992 to 1994 is similar to the pattern from Phase I monitoring, shown in Figure 11. Triazines are present in significant quantities after application, but persist in detectable quantities well into the winter. Nitrate-nitrogen concentrations are greatest in the late fall and winter, as is base-flow nitrate-nitrogen flux. Concentrations of atrazine-equivalent triazines exceeded the atrazine MCL only during three high-flow events in the spring of 1993 and four times during the spring of 1994, emphasizing the previously recognized importance of the relative timing of pesticide application and rainfall (Baker, 1980). The

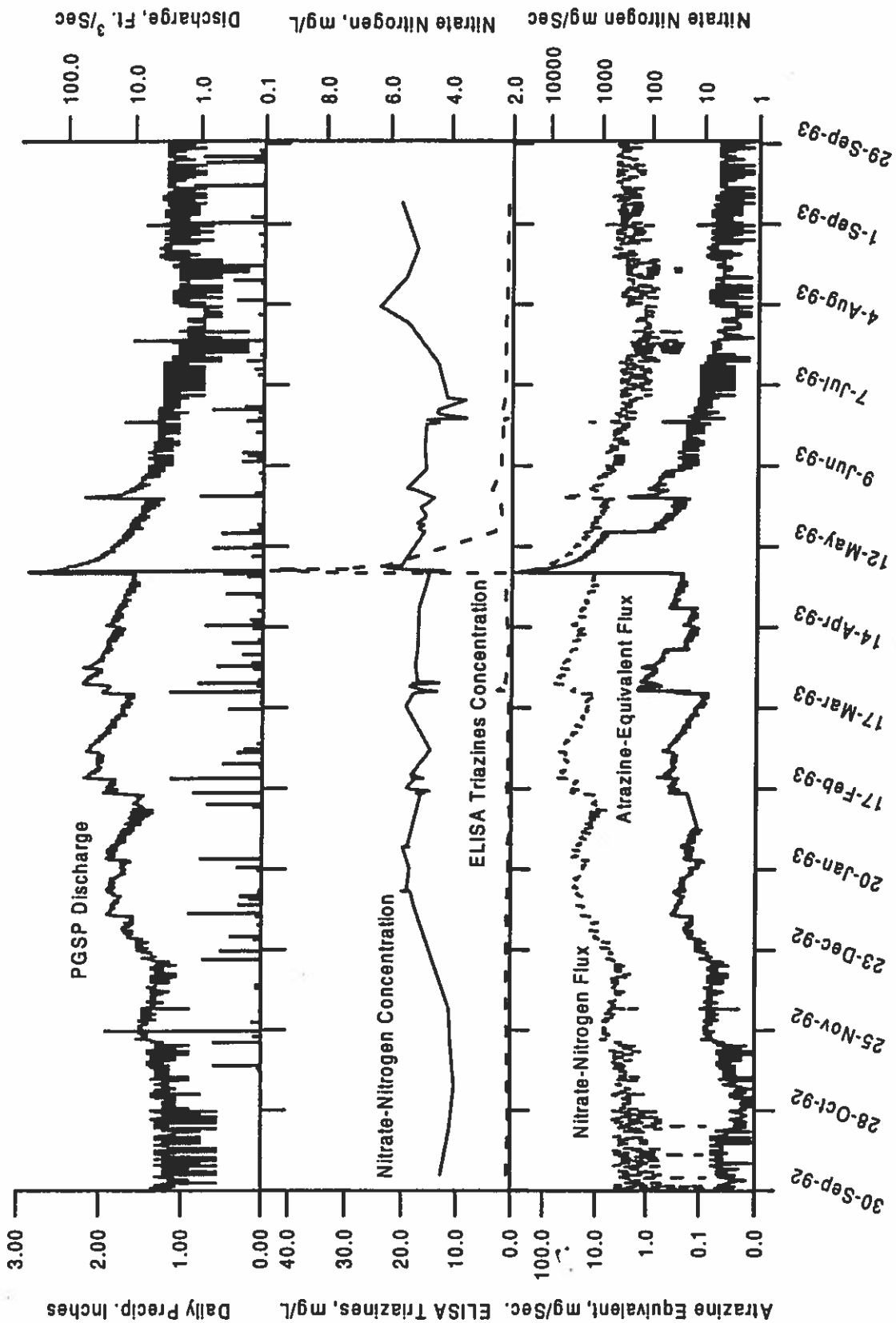

Figure 14. Plot of precipitation, discharge, nitrate-nitrogen concentration, nitrate-nitrogen flux, ELISA triazine concentration, and atrazine-equivalent flux for Pleasant Grove Spring for the 1992–93 water year.

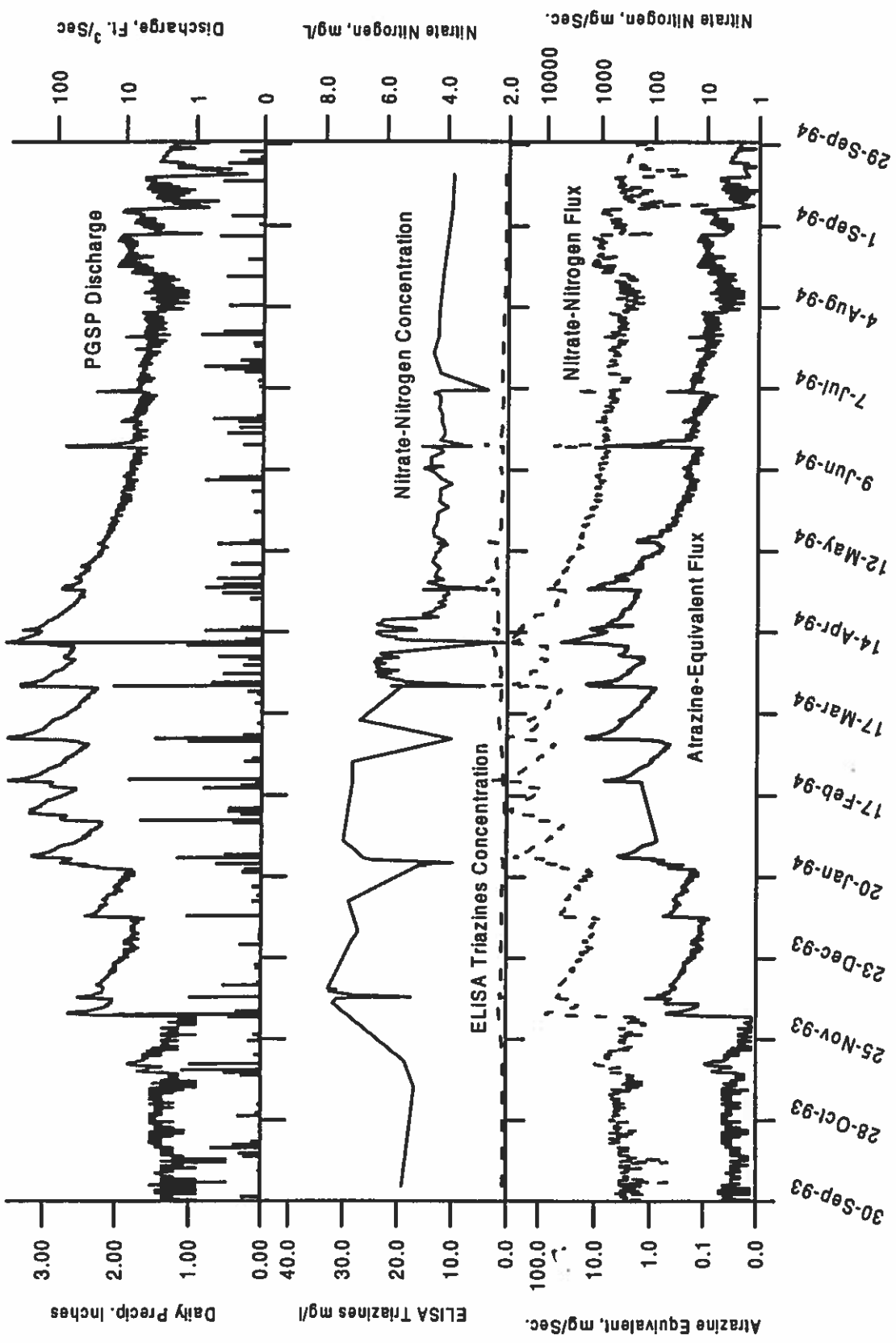

Figure 15. Plot of precipitation, discharge, nitrate-nitrogen concentration, nitrate-nitrogen flux, ELISA triazine concentration, and atrazine-equivalent flux for Pleasant Grove Spring for the 1993–94 water year.

striking contrast in triazine concentration and flux in May of 1993 versus May of 1994 is likely related to the timing of rainfall.

Total annual precipitation, discharge, mass flux of nitrate and atrazine-equivalent, crop, and other relevant data are presented in Table 3. The average discharge rate for water years 1992-93 and 1993-94 was 23.6 $ft.^3/sec.$ (6.7 $m^3/sec.$). For the 2 years, the flow-weighted averages of triazines at Pleasant Grove Spring, expressed as atrazine-equivalent, were 4.91 µg/L and 0.97 µg/L, respectively. For nitrate-nitrogen, flow-weighted average concentrations were less variable: 5.0 mg/L for 1992-93 and 5.7 mg/L for 1993-94. Approximately 11.5 percent of applied nitrogen fertilizer (15.86 pounds per acre of row crop [17.79 kg/ha]) was discharged at Pleasant Grove Spring during 1992-93, whereas only 0.033 lb./acre (0.037 kg/ha) of atrazine-equivalent per acre of corn, or 1.65 percent of the estimated atrazine applied, was discharged. Total nitrate-nitrogen mass flux was significantly higher in 1993-94 (203 short tons [184 metric tons]) than in 1992-93 (56 short tons [51 metric tons]) and significantly lower for atrazine-equivalent (68 pounds [31 kg]) in 1993-94 than in 1992-93 (110 pounds [50 kg]). The atrazine-equivalent flux for 1993-94 represents 1.0 percent of the estimated atrazine applied, whereas the nitrate flux represents an astounding 47.2 percent of the estimated applied nitrate-nitrogen. Precipitation was 34.6 inches (88 cm) in 1992-93 and 52.2 inches (209 cm) in 1993-94. Enhanced degradation of atrazine and increased leaching of nitrate in wet years has been noted by several authors (Johnston and others, 1967; Baker and others, 1978; Dao and others, 1979; Baker, 1980). The relatively wet spring of 1993-94 resulted in both greater degradation of atrazine, and multiple, lesser runoff events during application season than in 1992-93. For both years, annual mass-flux totals were substantially less for alachlor, carbofuran, and metolachlor than for atrazine-equivalent.

As mentioned in the introduction, an annual census of actual chemical applications was beyond the scope of this research. Pesticide sales data for distributors in Logan County were used as a relative indicator of trends in the use of pesticides. Sales data are reported by the Kentucky Division of Pesticides as pounds of active ingredient, rather than quantity of commercial product. Sales of atrazine in 1992 totaled 90,082 lbs., while sales in 1993 totaled 67,789 lbs. (Ernest Collins, personal communication, 1994), a 25 percent reduction. Corn production was 80 acres (32 ha) greater during 1993-94, virtually unchanged. A meeting was held with study-area farmers in February 1993 to explain the project and ask if they would support changes in BMP's. At this meeting preliminary data on the 1992-93 atrazine concentrations were released, possibly influencing farmers to use less atrazine. However, Pleasant Grove Spring Basin is only 3 percent of the area of Logan County, hardly sufficient to account for a 25 percent reduction in sales. Statewide, atrazine sales increased modestly from 1992 to 1993. Also, there is no direct link between general sales data and use in the basin. Still, if farmers in the basin conversing with other farmers in the county, press coverage of agriculture-related water issues, and communication by agricultural service agents served to reduce atrazine use, an organized education program seems promising.

The annual flux of metolachlor and carbofuran at Pleasant Grove Spring must be considered gross estimates because the correlation of ELISA and GC metolachlor was not as strong as for triazines, and no GC method for carbofuran was available at KGS. In 1992-93 the metolachlor discharge at Pleasant Grove Spring was 6.8 kg, and carbofuran was 0.5 kg. In 1993-94 the annual mass flux was 0.9 kg for metolachlor and 3.2 kg for carbofuran. The decrease in metolachlor was probably due to weather conditions. The increase in carbofuran is unexplained because carbofuran sales in Logan County decreased from 9,323 pounds in 1992 to 6,194 pounds in 1993.

Table 3. Summary of annual precipitation, discharge, and mass flux in the Pleasant Grove Spring Basin.

Water Year	Precipitation	Discharge	Percent Runoff	Crop Acres		Nitrate			Triazine	Atrazine-Equivalent	
				Corn	Total Row	Average Concentration	Mass Flux	Flow-Weighted Average	Average Concentration	Mass Flux	Flow-Weighted Average
1991-92[1]	39.52+[2] in.	NA	NA	3,639	6,851	4.20 mg/L	NA	NA	1.64 µg/L	NA	NA
1992-93	34.58 in.	3.6 X 10^8 $ft.^3$	28	3,348	7,105	4.98 mg/L	51,105 kg	5.0 mg/L	4.84 µg/L	50.163 kg	4.91 µg/L
1993-94	52.20 in.	11.3 X 10^8 $ft.^3$	57	3,428	6,261	4.86 mg/L	183,643 kg	5.7 mg/L	1.84 µg/L	30.751 kg	0.97 µg/L

[1]Continuous monitoring began in May-June 1992. Sampling began in February 1991.
[2]Russellville volunteer station. Incomplete record.

Annual Flux at Upstream Sites

As discussed above, stage records and flow data at Upper Pleasant Grove Creek and George Delaney swallow hole were not satisfactory for the estimation of mass flux. Flux was estimated for Leslie Page karst window, but both flow monitoring and sampling were not as complete as the initial site assessment suggested was possible. Nevertheless, estimates were calculated for LPKW for 1993-94 (Fig. 16). The nitrate-nitrogen flux was 4.9 short tons (4.5 metric tons) or 7.04 mg/L, flow-weighted average. Pesticide flux for atrazine-equivalent was 1.83 pounds (0.83 kg) or 1.3 µg/L flow-weighted average; metolachlor was 0.04 pounds (0.02 kg) or 0.04 µg/L flow-weighted average. The carbofuran flux was nearly zero. Although the catchment of LPKW has not been mapped, discharge indicates it is relatively small. Also, the fields immediately surrounding the site were mostly wheat and soybeans in 1993-94.

High-Flow Events at Pleasant Grove Spring

Numerous authors have demonstrated the critical importance of sampling karst springs at closely spaced intervals during high-flow events to quantify natural constituents and detect pollutants (Ashton, 1966; Quinlan and Alexander, 1987; Ogden, 1988). As discussed above, an attempt was made to sample every high-flow event during the planting season. The event samples were supplemented and bracketed by manually collected base-flow samples. Some high-flow events were also sampled manually. In addition, several fall and winter high-flow events were sampled during the 1992-93 water year. A common feature of many of these graphs is that whereas major runoff events resulted in lowered nitrate-nitrogen concentrations, triazine concentrations generally increased. However, increased mass flux of both atrazine-equivalent and nitrate-nitrogen is caused by the large increase in discharge. Concentrations of pesticides at Pleasant Grove Spring are commonly two orders of magnitude greater during springtime, high-flow events than during winter events. Also, most chemographs for storms during planting season have a positive relationship between total suspended solids and triazines. Cross-plots of total suspended solids versus triazines show no correlation, and there is no significant difference in triazine concentrations of filtered and unfiltered water samples from Pleasant Grove Spring. The apparent relationship between triazines and sediment for many Pleasant Grove Spring chemographs is caused by both constituents being common to runoff, rather than the sorption of atrazine on filterable sediment.

The June 1992 high-flow event occurred days after the installation of monitoring equipment at Pleasant Grove Spring was completed (Fig. 17). Approximately 1.6 inches (4 cm) of rain was recorded at the Russellville volunteer station between 19:00 on June 3 and 19:00 on June 4. Following the first rise in discharge, a small decrease in triazine concentration occurred, followed by a series of sharp rises in concentration that corresponded to dramatic increases in suspended sediment. The peaks in sediment also corresponded to decreases in nitrate concentration. During the recession, suspended sediment decreased significantly, nitrate-nitrogen increased to pre-event levels, and triazine steadily increased, then dropped off toward pre-event concentrations. The relationship between sediment, nitrate-nitrogen, and triazines indicates that runoff diluted the nitrate, while carrying significant concentrations of triazines.

Data from storms in February 1993 show somewhat different results (Fig. 18). The February 15 storm accumulated 0.87 inch (2.2 cm) over 17 hours at the Pleasant Grove Spring rain gage. Daytime temperatures were above 40°F (4.4°C), but dipped below freezing on the morning of February 17. The discharge hydrograph and chemographs show only moderate increases in discharge and turbidity, whereas specific conductivity, triazine, and nitrate-nitrogen decreased. The February 21 storm was more intense, resulting in 1.12 inches (2.8 cm) accumulated in only 5 hours. Temperatures were above freezing. While specific conductivity went down, stage and turbidity increased significantly. Triazine concentration increased slightly, but overall both changed little in concentration. Discharge and turbidity increased dramatically, although cover on the fields was largely unchanged between storms. The two February events revealed that the triazine concentrations were much lower than those measured during the previous planting season and that the remaining nitrate, low concentrations of triazines, and significant sediment loss are mobilized by storms that are relatively intense.

In May 1993 the greatest concentration of triazines and GC atrazine determined for Pleasant Grove Spring occurred during a high-flow event beginning in the evening of May 3 and lasting through May 4 (Fig. 19). Approximately 3.04 inches (7.7 cm) of rain fell during the afternoon and evening of May 3. Data recorded during the event are less than ideal because the water-quality logger probes were fouled and the intake lines of the ISCO samplers were crimped. No samples were

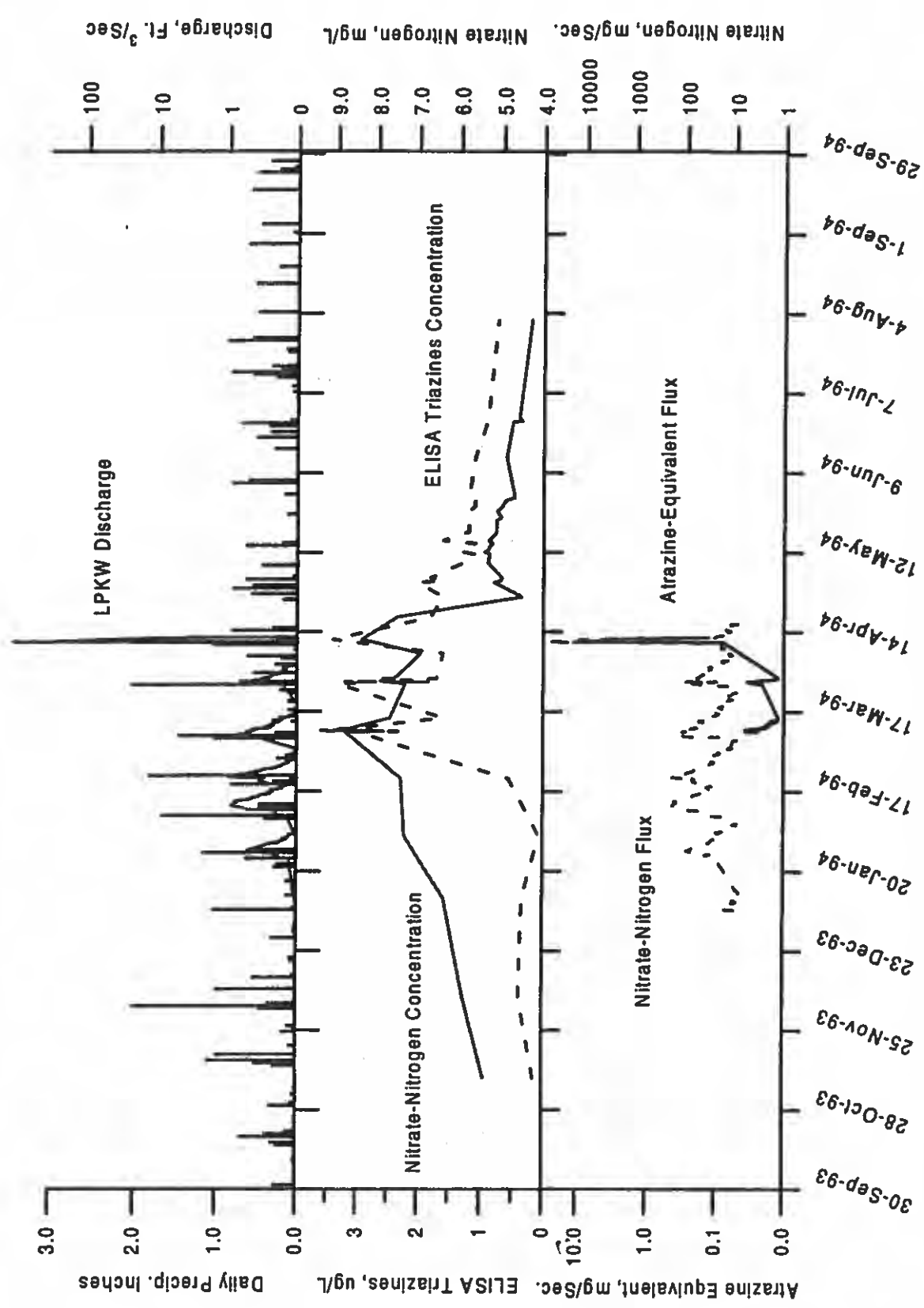

Figure 16. Plot of precipitation, discharge, nitrate-nitrogen concentration, nitrate-nitrogen flux, ELISA triazines concentration, and atrazine-equivalent flux for Leslie Page karst window for the 1993-94 water year.

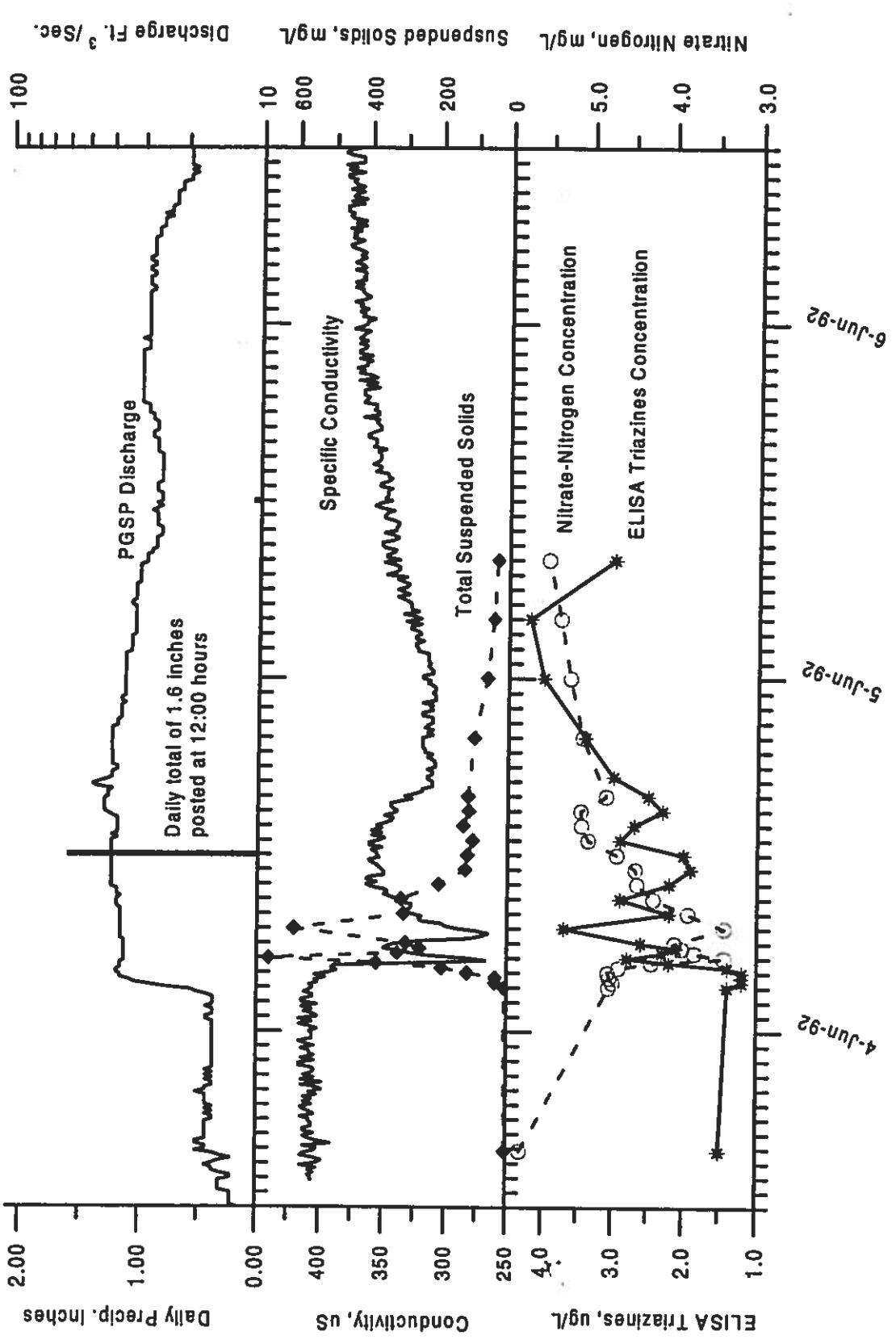

Figure 17. Discharge hydrograph and chemographs for the June 1992 high-flow event at Pleasant Grove Spring. Note the opposite deflection of the nitrate and triazine concentrations.

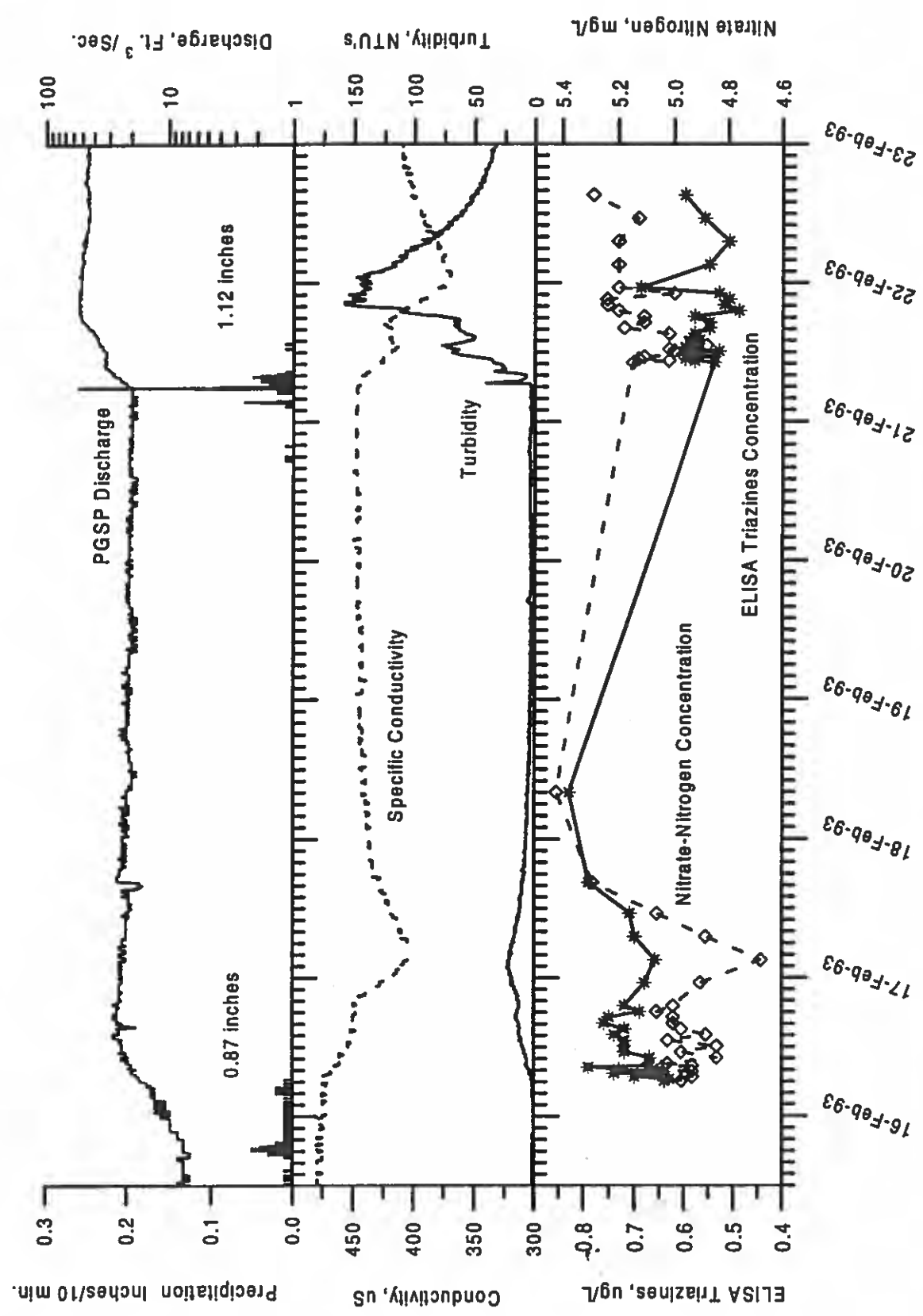

Figure 18. Discharge hydrograph and chemographs for the February 1993 high-flow events at Pleasant Grove Spring, showing variable response to late winter storms of different intensity.

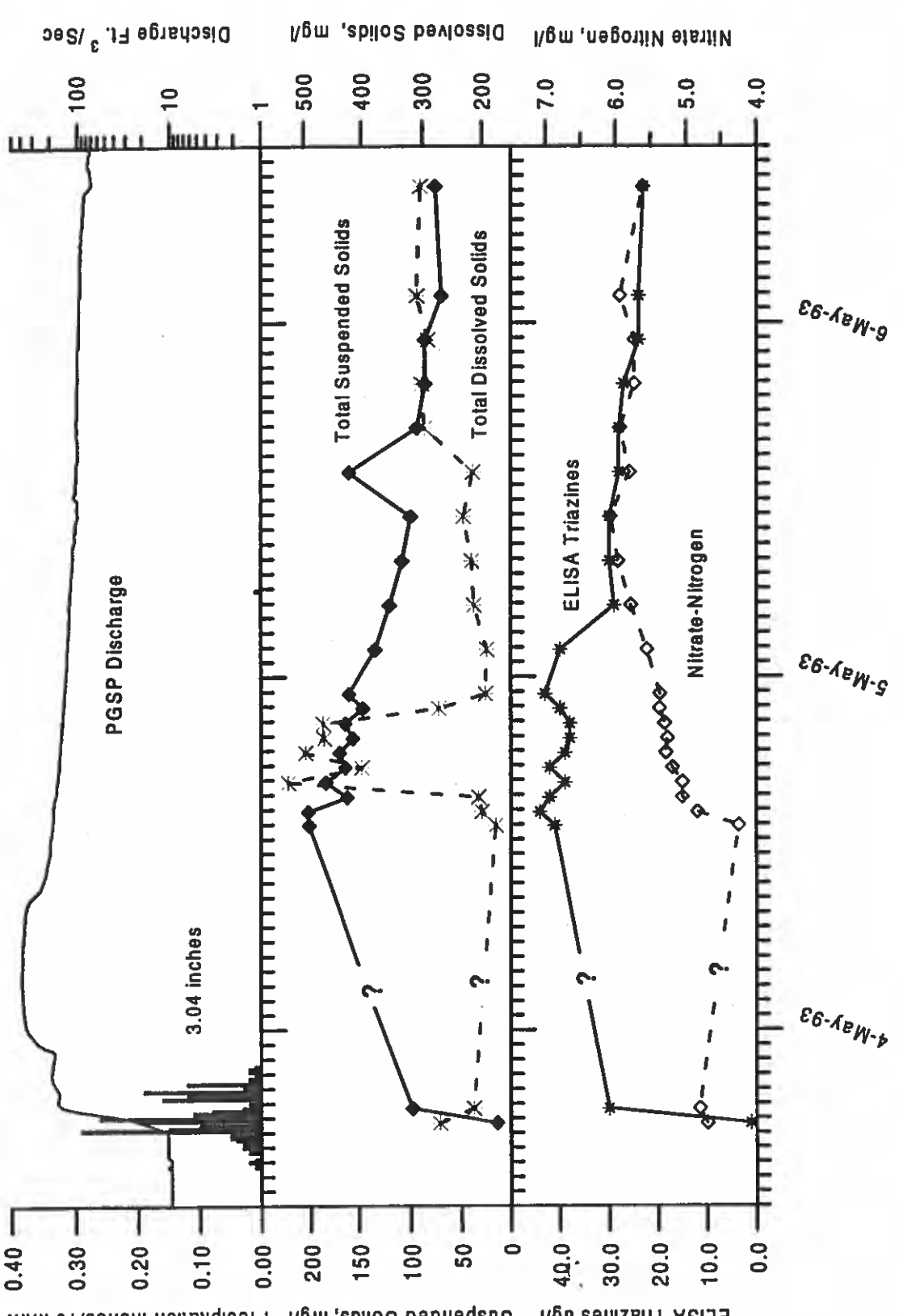

Figure 19. Chemographs and discharge hydrograph for the May 1993 high-flow event at Pleasant Grove Spring, illustrating highest triazine concentrations recovered to date.

collected during peak flow. The highest concentration of pesticide detected was 44.0 µg/L of triazines, which occurred during high flow, and is indicated on the recession limb of the hydrograph. A sample collected manually the same day contained 28.0 µg/L atrazine (GC). Maximum triazine concentrations were probably greater than those measured. The event contributed at least 44.5 kg of atrazine-equivalent, 88.7 percent of the 1993 annual mass flux. In addition, sediment transport during this storm was significant. Total suspended sediment concentrations reached a maximum of 202 mg/L, and turbidity values exceeded 1,000 nephelometric turbidity units (NTU's), the maximum range of the turbidity probe. Sediment was deposited to depths of 2 inches (5 cm) in the channel and on the banks of Pleasant Grove Creek for hundreds of feet downstream of the spring. At the time of the storm, a large number of fields had been simultaneously tilled, and crops had not yet emerged. A biological inventory conducted downstream of the spring in 1994 by the Kentucky Division of Water revealed Pleasant Grove Creek was biologically impaired, probably by sediment (Sampson, 1995).

High-flow events on December 4 and 10, 1993, revealed the presence of triazines at Pleasant Grove Spring in concentrations as high as 1.5 µg/L up to 8 months after the application season. No analyses are available for the storm on December 4, but wetting of the soil after a very dry fall (Fig. 20) may have mobilized triazines stored in the soil and diffuse-flow zone. The December 10 rainfall then flushed triazines into the conduit system. However, the concentration of triazines at PGSP fell as runoff flowing directly into swallow holes diluted the relatively limited mass of triazine and nitrate-nitrogen stored in the aquifer. The presence of triazines in these concentrations strongly suggests that some agricultural chemicals are being stored in ground water, or soil, over sufficiently long periods to make exposure to these compounds from ground water used for drinking a nearly year-round occurrence.

The timing of the arrival of runoff from the headwaters of the basin at Pleasant Grove Spring is important to understanding the origin of contaminants. Only one quantitative ground-water dye trace was completed in time for this report, but some storm events have provided insight into travel times from George Delaney swallow hole, the principal insurgence during most events. A storm producing 1.04 inches (2.64 cm) of rain began at 22:40 on January 6, 1994, reached its maximum intensity at midnight, and ended by 04:00 on January 7. This storm broke a 4-week-long period with total precipitation of only 2.3 inches (5.8 cm). Air temperature steadily fell during the early morning of January 7 and was below freezing by 09:50. The stage recorder at GDSW began to rise at midnight and peaked at 07:50 on January 7 (Fig. 21). Discharge at PGSP began to rise at 00:50 on January 7 and peaked at 12:10. Velocity rose synchronously with discharge. However, conductivity and water temperature remained constant until 10:00, when a small dip was measured, followed by a rapid decline beginning at 13:00 and reaching a minimum value at 17:10 and 19:00, respectively. Turbidity rose rapidly at 06:00, declined to pre-event readings, then began rising again at 09:00, peaking at 15:20. The early peak in turbidity is interpreted as the arrival of runoff from Spring Valley karst window, only 3,000 feet (914 m) upstream of Pleasant Grove Spring, which has a heavily grazed and trampled local catchment. The second peak in turbidity at 15:20, and the minimum in conductivity at 17:10, are interpreted as the arrival of inflow from George Delaney swallow hole. The delayed temperature minimum is due to warming of the runoff by the thermal mass of the bedrock. Under these flow conditions, the expected travel time to Pleasant Grove Spring after a storm peak is about 7 hours from Spring Valley karst window and 15 hours from George Delaney swallow hole. Average straight-line velocity from GDSW is 0.20 ft./sec., while velocity along the hypothesized flow route is 0.26 ft./sec.; both values are in general accordance with dye traces and the monitored apparent velocity.

Although a sediment mass flux had not been estimated due to the poor record from the turbidity probe, the probe generally performs well during the winter when biological growth rates are slow. High-flow events in late January 1994 revealed an apparent contradiction between periods of turbidity and high flow-velocities from the spring mouth (Fig. 22). Air temperatures during all three storms were above freezing. Both turbidity and velocity values would be expected to be simultaneously higher if the faster flowing water were consistently entraining sediment from the conduits. However, on Janaury 25 and 26 turbidity exceeded 100 NTU's, then returned to pre-event levels of approximately 25 NTU's, while velocity rose to nearly 1 foot per second. An event on Janaury 27 raised both turbidity and velocity, as expected. Another period of rain early on January 28 again elevated velocity, but only briefly elevated turbidity, which quickly returned to pre-event levels. As in the case of the January 7 storm, conductivity and water temperature indicate the turbidity is associated with runoff rather than mobilized sediment that has been stored in the conduits. The discordance of turbidity and velocity during the late January storms indicates that ground conditions during the storm, such as type of cover crops, amount of crop resi-

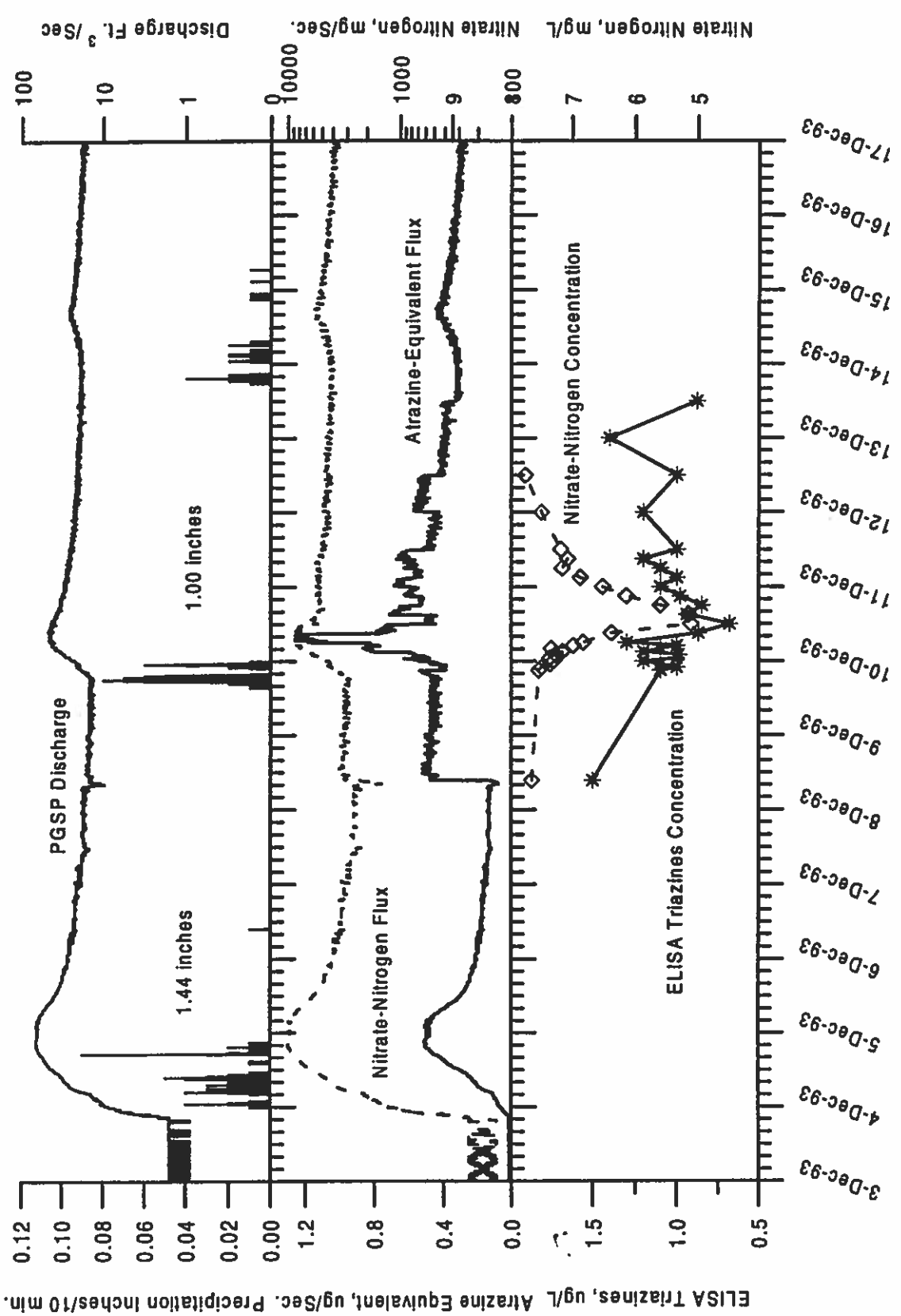

Figure 20. Plot of discharge hydrograph and chemographs, showing elevated atrazine-equivalent flux during an early winter high-flow event.

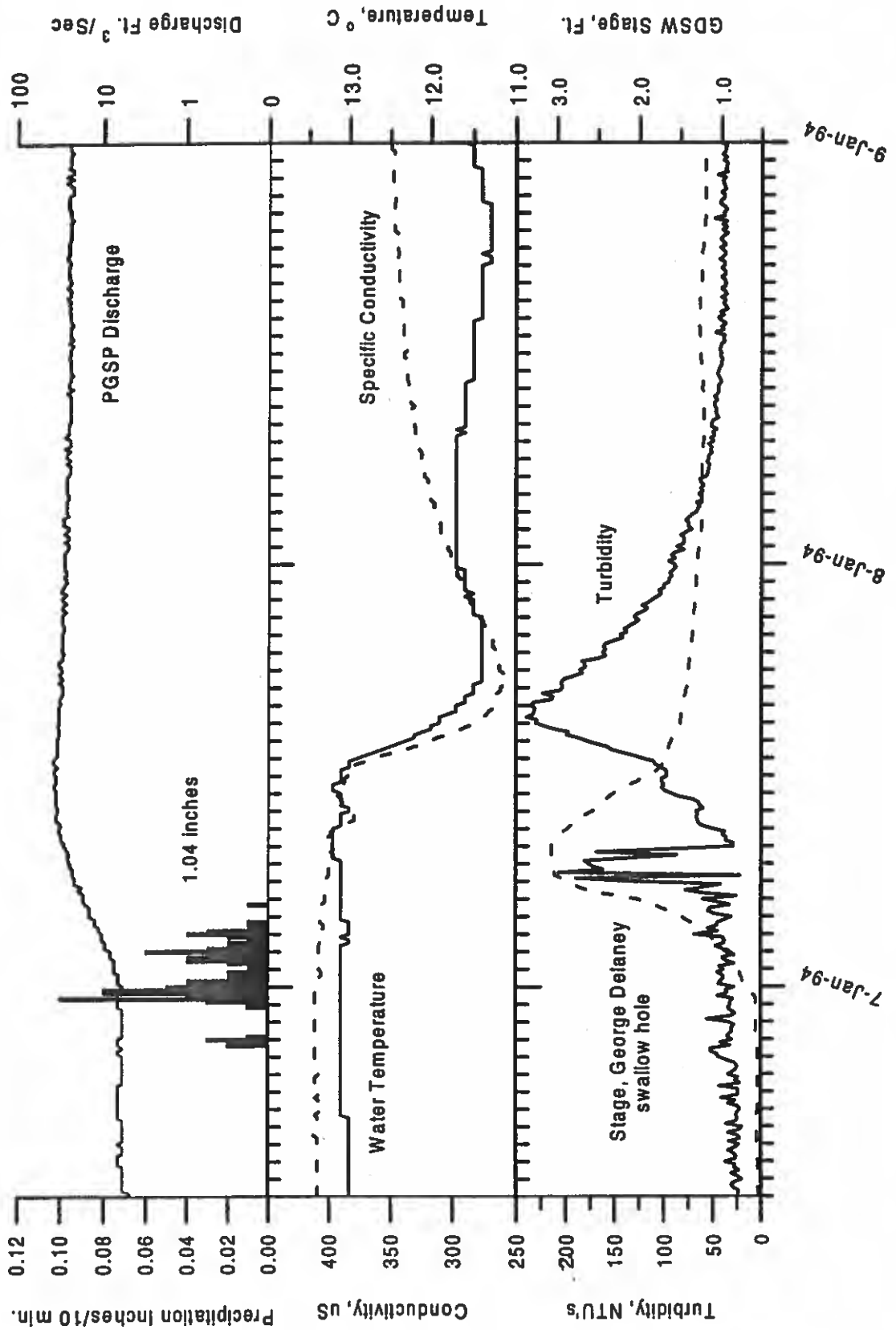

Figure 21. Stage hydrograph for George Delaney swallow hole and discharge hydrograph and chemographs for Pleasant Grove Spring, illustrating flow travel time from GDSH.

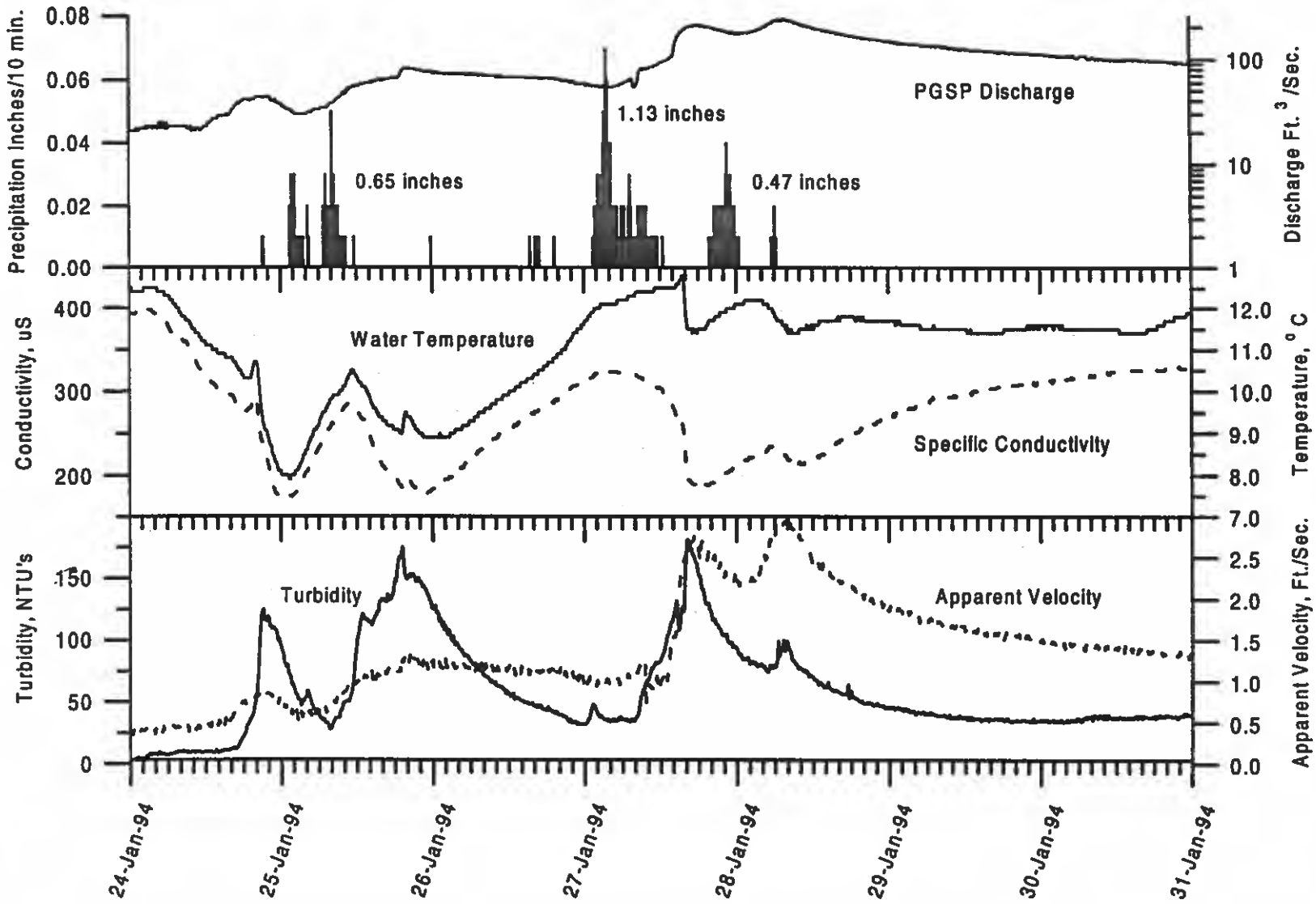

Figure 22. Chemographs and discharge hydrograph for Pleasant Grove Spring, illustrating the discordance of the occurrence of turbidity relative to velocity increases.

due, depletion of loose particles by earlier storms, cohesion due to wetting, and frozen ground, have a tremendous influence on sediment loss.

The March 27, 1994, event (3.3 inches [8.3 cm] of precipitation between 18:50 March 26 and 09:00 March 31) also transported significant volumes of sediment (Fig. 23). The discharge hydrograph, total suspended solids, total dissolved solids, total nitrate-nitrogen, and triazines are presented in Figure 23. The triazine peak is notable because the triazine concentrations do not synchronously rise with total suspended solids. The lack of a relationship, as shown in Figure 24, is thought to be caused by the storm occurring early in the application season when only some of the fields had had chemicals applied.

The maximum total suspended sediment concentration sampled from Pleasant Grove Spring to date is 2,278 mg/L (Fig. 24). This sample was collected at 23:45 on April 29, 1994, during an event that began with only 0.70 inch (1.7 cm) of rain at noon. Farm fields that are plowed are highly vulnerable to soil loss between the time they are tilled and before crops have grown sufficiently to provide cover. Although most fields in the Pleasant Grove Spring Basin are no-till or minimum tillage, a number of fields are plowed by conventional methods. The months between March and June consistently have the highest suspended sediment concentrations. The April 29 event is also an excellent example of the dilution of nitrate concentrations and the enhancement of pesticide concentrations by the arrival of runoff at the spring.

SUMMARY

During Phase I, mapping of the basin boundary was completed, monitoring sites were located, and contaminants present in the watershed were identified. The Pleasant Grove Spring drainage was determined to include approximately 10,291 acres (4,165 hectares), of which roughly 92 percent is in agricultural production. Non-agricultural activities in the watershed are minimal. The basin can be divided into two ground-water flow regimes: slow (diffuse) and fast (conduit). Ground-water flow rates in the fast, conduit-flow regime are measured in days, whereas flow rates in the slow, conduit-flow regime are measured in weeks.

Analysis of water samples collected during Phase I suggests that nonpoint-source pollution, including chemical compounds used by agriculture, is ubiquitous in the ground water of the Pleasant Grove Spring karst drainage basin. Contaminants of concern are triazine herbicides, bacteria, and sediment. Nutrients such as nitrate and orthophosphate are also present in higher than natural concentrations, but generally do not exceed drinking-water standards. Volatile organic compounds were absent from two samples collected at both Leslie Page karst window and Pleasant Grove Spring.

Phase II included the instrumentation of monitoring sites and the collection of data during storm events. Also, a well inventory was conducted and a potentiometric map was constructed from water levels measured in wells. Triazine concentrations at Pleasant Grove Spring exceed drinking-water standards during storms in the planting season, and triazines persist in the ground water through most of the year. Carbofuran, metolachlor, and alachlor are detected in significant concentrations during the planting season.

Atrazine-equivalent losses in 1992-93 were 0.033 lb./acre (0.037 kg/ha) or 1.65 percent of that applied for a flow-weighted average of 4.91 µg/L. Atrazine-equivalent loss in 1993-94 was at a flow-weighted average of 0.97 µg/L (1.0 percent of applied). Nitrate-nitrogen losses for 1992-93 were 15.86 lbs./acre (17.7 kg/ha) or 11.5 percent applied to crops in the basin. Losses of nitrate-nitrogen were 47.2 percent in 1993-94. The mass flux of sediment was not calculated, but is significant. Mass flux of other pesticides was significantly less. The smaller atrazine-equivalent loss and greater nitrate-nitrogen loss may be caused by changes in application rates, but more likely by wetter weather conditions.

Bacteria counts at Pleasant Grove Spring during both Phase I and Phase II averaged hundreds of colonies per 100 ml and were always above drinking-water standards, and occasionally above water-supply limits. However, speciation analysis and sampling for optical brightener failed to identify the source of the bacteria. Fecal coliform to fecal streptococci ratios are also ambiguous, suggesting either animal or human sources, depending on flow. Bacteria levels were lower following installation of an animal waste facility on Upper Pleasant Grove Creek. High streptococci counts followed by high coliform counts tentatively suggest animal waste is mobilized early in the rainy season, followed by mobilization of human waste later in the season.

Monitored high-flow events reveal the complex interrelationship of chemical application, tillage, and weather to contaminant transport. Also, the arrival of higher nitrate concentrations and the recovery of triazine concentrations, temperature, and conductivity values to pre-event levels supports the model of a diffuse-flow zone storing chemicals and moderating water-quality changes.

CONCLUSIONS

Water-quality data indicate that nonpoint-source pollution by chemical compounds used in agriculture

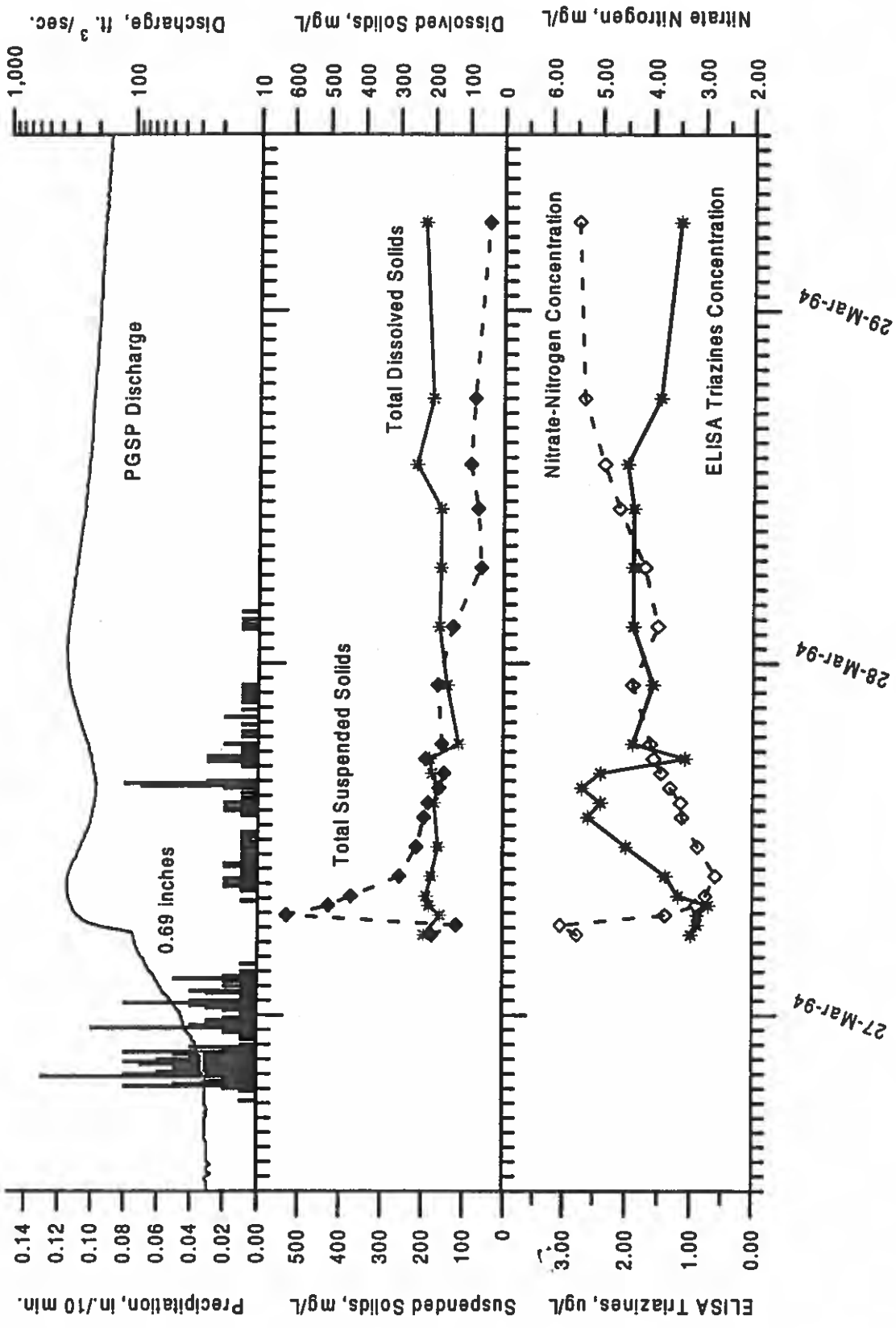

Figure 23. The March 1994 high-flow event showing the discordance of ELISA triazines and both dissolved and suspended solids.

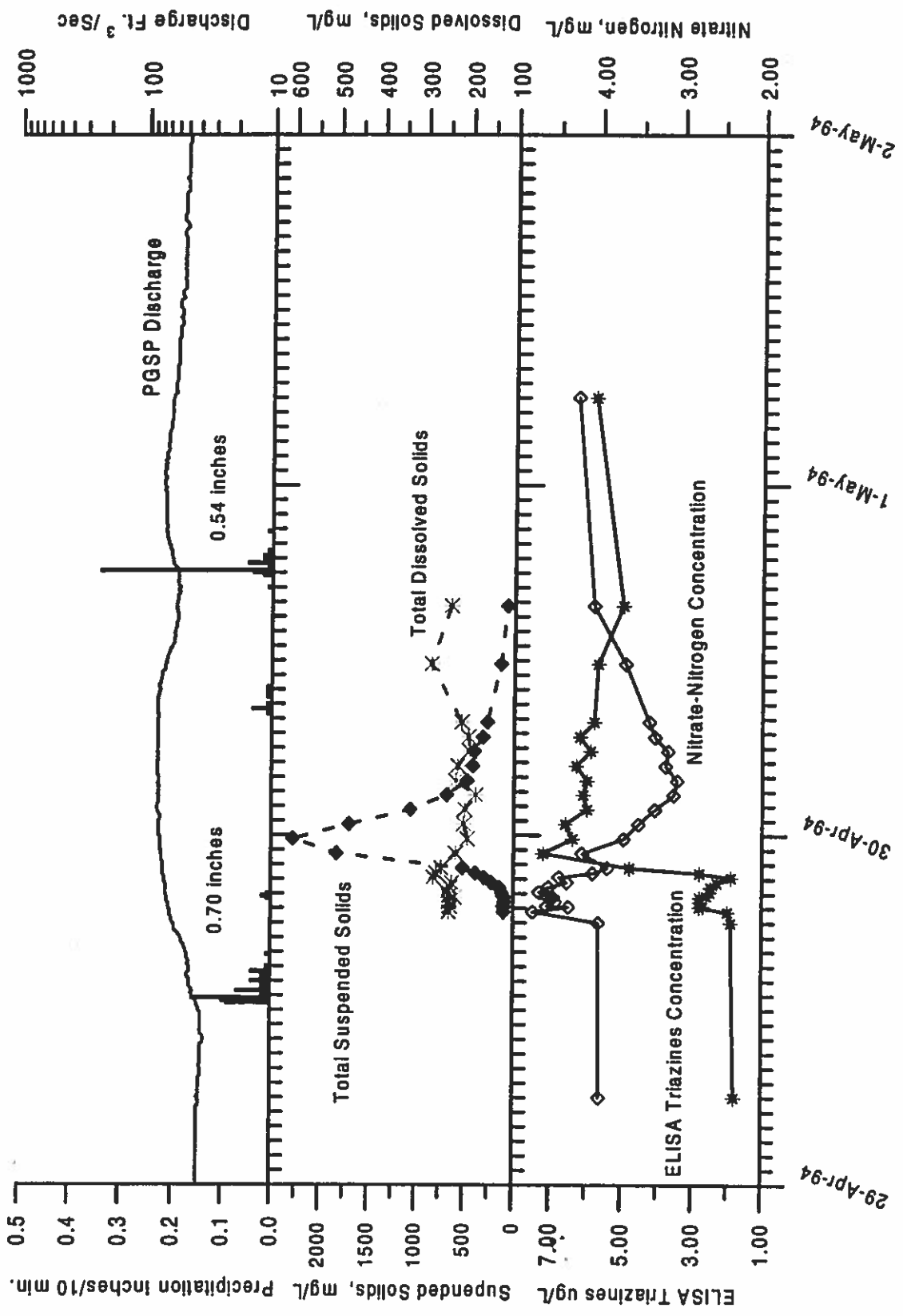

Figure 24. Discharge hydrograph and chemographs for the April 29, 1994, high-flow event at Pleasant Grove Spring.

is ubiquitous in the ground water of the Pleasant Grove Spring karst drainage basin. Concentrations of atrazine above drinking-water limits generally occur only after significant rainfall events immediately following the planting season (when pesticides are applied). The peak atrazine concentrations are of environmental concern. Nitrate losses, while not an urgent ecological problem, suggest significant economic loss to farmers. Bacteria counts improved following the installation of an animal waste facility, but remain a drinking-water concern. Sediment is recognized as a major pollutant, but remains unquantified. Findings indicate that planned BMP implementation should focus on controlling animal waste, controlling crop field runoff with associated sediment and pesticide loss, and more efficient nutrient application methods.

The hydrogeology of the basin has a significant impact on the temporal variation of contaminant concentrations. The fast-flow conduit region is characterized by intermediate concentrations of nitrate and pesticides during low flow but substantially higher concentrations of triazines and lower concentrations of nitrate during high flow. The diffuse-flow (slow-flow) regime area, which is estimated to represent slightly less than half of the basin, drains into the area dominated by conduit flow. The diffuse-flow region has persistently higher concentrations of nitrate and lower, but less variable, concentrations of triazines. The diffuse, slow-flow area is acting as a reservoir of agricultural chemicals, maintaining a background level of triazines and nitrate during low flow in the conduit-flow regime. Triazine concentrations are significantly higher during high flow, while nitrate concentrations are diluted.

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APPENDIX A:
Discharge Observations of Springs and Streams in the Pleasant Grove Spring Drainage Basin

Pleasant Grove Spring

Date	*Time (CST)*	*Conditions*	*Stage*	*Discharge*
Aug/02/1990	11:00 Hours			1.30 cfs
Feb/28/1991	09:10 Hours			51.20 cfs
Apr/09/1991	14:45 Hours			47.50 cfs
Apr/09/1991	15:28 Hours			44.93 cfs
Apr/11/1991	13:40 Hours			44.76 cfs
Apr/11/1991	14:38 Hours			41.93 cfs
Apr/11/1991	12:20 Hours			41.70 cfs
May/01/1991	10:17 Hours			19.70 cfs
May/22/1991	12:23 Hours			37.70 cfs
Jun/26/1991	11:24 Hours			22.40 cfs
Jul/25/1991	11:20 Hours			5.55 cfs
Aug/29/1991	13:40 Hours			2.53 cfs
Sep/24/1991	10:46 Hours			1.85 cfs
Oct/22/1991	08:50 Hours			1.50 cfs
Dec/17/1991	08:06 Hours	falling	2.42 ft.	59.40 cfs
Jan/29/1992	10:50 Hours	stable	1.85 ft.	11.98 cfs
Feb/26/1992	11:50 Hours	stable	1.96 ft.	14.92 cfs
Mar/25/1992	13:55 Hours	stable	2.00 ft.	32.65 cfs
Apr/29/1992	11:10 Hours	falling	1.89 ft.	7.42 cfs
May/27/1992	11:45 Hours	stable	1.80 ft.	1.90 cfs
Jun/03/1992	15:20 Hours	rising	1.93 ft.	11.64 cfs
Jun/04/1992	14:10 Hours	falling	2.36 ft.	48.66 cfs
Jun/18/1992	08:20 Hours	falling	1.88 ft.	12.76 cfs
Jul/22/1992	17:00 Hours	rising	1.74 ft.	7.52 cfs
Jul/23/1992	13:50 Hours	falling	1.74 ft.	5.93 cfs
Aug/26/1992	11:10 Hours	falling	1.66 ft.	2.96 cfs
Oct/06/1992	15:40 Hours	falling	1.64 ft.	2.63 cfs
Nov/06/1992	09:00 Hours	falling	1.68 ft.	2.46 cfs
Dec/02/1992	09:50 Hours	falling	1.76 ft.	2.82 cfs
Jan/07/1993	16:00 Hours	stable	2.06 ft.	24.15 cfs
Jan/08/1993	12:20 Hours	falling	2.06 ft.	22.33 cfs
Feb/04/1993	11:40 Hours	falling	1.90 ft.	12.41 cfs
Mar/03/1993	10:10 Hours	falling	2.50 ft.	55.47 cfs
Apr/07/1993	09:10 Hours	falling	2.17 ft.	29.36 cfs
May/04/1993	13:10 Hours	falling	4.24 ft.	188.34 cfs
May/05/1993	10:10 Hours	falling	3.08 ft.	88.64 cfs
May/05/1993	12:10 Hours	falling	3.04 ft.	111.30 cfs
Aug/04/1993	10:00 Hours	stable	1.66 ft.	3.04 cfs
Sep/09/1993	07:50 Hours	falling	1.62 ft.	1.84 cfs
Oct/06/1993	07:00 Hours	falling	1.61 ft.	1.74 cfs
Nov/09/1993	11:40 Hours	falling	1.64 ft.	1.36 cfs
Mar/28/1994	15:22 Hours	falling	4.42 ft.	128.94 cfs
Apr/11/1994	13:52 Hours	stable	7.45 ft.	463.38 cfs
Apr/11/1994	18:17 Hours	falling	7.13 ft.	434.88 cfs

Pleasant Grove Spring (Continued)

Date	Time (CST)	Conditions	Stage	Discharge
Apr/11/1994	14:24 Hours	falling	7.30 ft.	457.53 cfs
Apr/12/1994	09:00 Hours	falling	5.52 ft.	237.35 cfs
Aug/03/1994	09:20 Hours	stable	1.68 ft.	3.67 cfs

Spring Valley karst window

Date	Time (CST)	Conditions	Stage	Discharge
Aug/02/1990	10:21 Hours			2.39 cfs
Feb/28/1991	10:51 Hours			58.90 cfs
Apr/09/1991	10:24 Hours			32.40 cfs
Apr/11/1991	10:46 Hours			45.50 cfs
Jun/26/1991	12:00 Hours			20.08 cfs
Jul/25/1991	10:30 Hours			5.23 cfs
Aug/29/1991	12:40 Hours			2.80 cfs
Sep/24/1991	09:24 Hours			2.36 cfs
Oct/22/1991	09:30 Hours			4.50 cfs
Jan/29/1992	10:00 Hours			11.82 cfs
Feb/26/1992	11:00 Hours			15.44 cfs
Mar/25/1992	11:10 Hours			29.77 cfs
Apr/29/1992	09:36 Hours			7.40 cfs
May/27/1992	10:15 Hours			2.32 cfs
Jul/23/1992	12:50 Hours			5.80 cfs
May/20/1993	09:10 Hours	falling	1.18 ft.	16.19 cfs
Jun/02/1993	12:20 Hours	stable	1.10 ft.	12.87 cfs
Jun/17/1993	08:50 Hours	falling	.83 ft.	6.77 cfs
Jun/30/1993	11:10 Hours	falling	.79 ft.	5.05 cfs
Sep/07/1993	14:20 Hours	stable	.72 ft.	1.80 cfs
Nov/08/1993	16:20 Hours	stable	1.08 ft.	1.28 cfs
Dec/07/1993	16:44 Hours	falling	1.54 ft.	21.95 cfs

The Canyon karst window

Date	Time (CST)	Conditions	Stage	Discharge
Aug/02/1990	09:13 Hours			0.11 cfs
May/01/1991	09:31 Hours			0.13 cfs
May/22/1991	09:56 Hours			8.70 cfs
Jun/26/1991	08:58 Hours			0.13 cfs
Jul/25/1991	09:35 Hours			0.14 cfs
Aug/29/1991	11:55 Hours			0.02 cfs
Sep/24/1991	08:40 Hours			0.01 cfs
Jan/29/1992	08:35 Hours			0.09 cfs
Feb/26/1992	09:32 Hours			0.14 cfs
Apr/29/1992	08:40 Hours			0.10 cfs
May/29/1992	11:05 Hours			0.02 cfs

Shackelford Spring

Date	Time (CST)	Conditions	Stage	Discharge
Feb/28/1991	12:59 Hours			0.48 cfs
May/01/1991	08:05 Hours			0.57 cfs
Jul/25/1991	08:20 Hours			0.54 cfs
Aug/29/1991	11:13 Hours			0.29 cfs
Sep/24/1991	07:48 Hours			0.12 cfs
Dec/17/1991	12:35 Hours			0.96 cfs
Jan/28/1992	14:21 Hours			0.33 cfs
Feb/26/1992	08:47 Hours			0.78 cfs
Mar/25/1992	09:02 Hours			0.58 cfs
Apr/29/1992	07:43 Hours			0.16 cfs

Thad Flowers bluehole

Date	Time (CST)	Conditions	Stage	Discharge
Feb/28/1991	12:12 Hours			0.55 cfs
May/01/1991	08:13 Hours			0.02 cfs
May/22/1991	07:17 Hours			0.20 cfs
Dec/17/1991	13:35 Hours			0.87 cfs
Mar/25/1992	07:45 Hours			0.50 cfs

George Delaney swallow hole

Date	Time (CST)	Conditions	Stage	Discharge
May/22/1991	11:25 Hours			8.75 cfs
Jun/26/1991	09:45 Hours			3.15 cfs
Jul/25/1991	09:55 Hours			0.01 cfs
Dec/17/1991	10:15 Hours			18.30 cfs
Jan/29/1992	09:17 Hours			1.64 cfs
Feb/26/1992	10:20 Hours			3.18 cfs
Mar/25/1992	10:03 Hours			10.46 cfs
May/20/1993	08:00 Hours	falling	1.46 ft.	2.29 cfs
Jun/03/1993	08:50 Hours	stable	.71 ft.	1.36 cfs
Jun/03/1993	09:02 Hours	stable	.71 ft.	1.26 cfs
Jun/17/1993	08:20 Hours	falling	.14 ft.	0.00 cfs
Jun/17/1993	08:15 Hours	falling	.14 ft.	0.00 cfs
Dec/07/1993	12:03 Hours	falling	1.07 ft.	6.15 cfs
Jan/11/1994	15:45 Hours	falling	1.16 ft.	10.81 cfs
Mar/03/1994	08:26 Hours	falling	2.50 ft.	12.29 cfs
Jun/02/1994	11:28 Hours	stable	.68 ft.	0.60 cfs

Leslie Page karst window

Date	*Time (CST)*	*Conditions*	*Stage*	*Discharge*
May/05/1993	09:20 Hours		.78 ft.	0.48 cfs
May/20/1993	11:10 Hours	falling	.62 ft.	0.01 cfs
Jun/02/1993	10:10 Hours		.63 ft.	0.02 cfs
Jun/17/1993	09:50 Hours	falling	.61 ft.	0.04 cfs
Jun/30/1993	10:00 Hours	falling	.59 ft.	0.00 cfs
Sep/07/1993	14:40 Hours		.50 ft.	0.25 cfs
Oct/05/1993	12:40 Hours	falling	.50 ft.	0.00 cfs
Dec/07/1993	16:07 Hours	falling	.62 ft.	0.07 cfs
Dec/07/1993	16:07 Hours	falling	.62 ft.	
Jan/11/1994	14:06 Hours	stable	,72 ft.	0.08 cfs
Feb/02/1994	09:45 Hours	falling	.76 ft.	0.41 cfs
Feb/22/1994	13:34 Hours	rising	.86 ft.	0.32 cfs

Upper Pleasant Grove Creek

Date	*Time (CST)*	*Conditions*	*Stage*	*Discharge*
Jun/17/1993	07:40 Hours	falling	.40 ft.	1.31 cfs
Jun/30/1993	09:00 Hours		.40 ft.	0.37 cfs
Sep/07/1993	15:16 Hours	stable	.18 ft.	0.00 cfs
Dec/07/1993	15:00 Hours	falling	1.14 ft.	9.57 cfs
Feb/22/1994	15:27 Hours	rising	2.50 ft.	61.91 cfs

APPENDIX B:
Analytical Methods, Sample Containers, Preservatives, and Holding Times used for Samples Collected in the Pleasant Grove Spring Basin During Phases I and II

Analytical methods for water samples are listed in Table B-1. Comprehensive (C) samples include every analyte on the list except bacteria and field pH, temperature, total alkalinity, and conductivity. Analytes included in base flow (B) and event (E) sampling are indicated under the heading "Analysis Suite." Bacteria, volatile organics, and optical brightener analyses are topical (T) and may be collected by themselves or in conjunction with another analysis suite.

Pesticide concentrations were determined by two methods: gas chromatograph (GC) with either a nitrogen-phosphorus detector (method 507) or electron-capture (method 508), and enzyme-linked immunosorbent assay (ELISA) or immunoassay. All samples collected before April 1992, and some samples collected after that date, were analyzed for pesticides by gas chromatograph. Beginning in April 1992 all samples were also analyzed by ELISA for triazine herbicides (collectively, atrazine, simazine, and cyanazine), alachlor, metolachlor, 2,4-D, and carbofuran. Because there were no results above detection limit for 2,4-D during the first year, analysis for 2,4-D was discontinued. Pesticide results after April 1992 reported in this document are ELISA unless otherwise noted.

The GC method provides a more accurate analysis, but is expensive and therefore used less often. For a few exceptions the reported GC analyses of some pesticides may have a slightly lower detection limit than those listed here. The pesticides determined by gas chromatograph and their detection limits in micrograms per liter are listed in Table B-2.

The Kentucky Geological Survey Water-Quality Laboratory used Ohmicron "RaPID Assay" ELISA kits for all immunoassay analyses. The following description of the ELISA analytical method is excerpted from Ohmicron Corporation literature (1991) that accompanies each kit and is generally applicable to all Ohmicron kits:

> The sample to be tested is added, along with an enzyme conjugate, to a disposable test tube, followed by paramagnetic particles with antibodies specific to triazines attached. Both the atrazine (which may be in the sample) and the enzyme labeled atrazine (the enzyme conjugate) compete for antibody binding sites on the magnetic particles. At the end of an incubation period, a magnetic field is applied to hold the paramagnetic particles (with atrazine and labeled atrazine analog bound to the antibodies on the particles, in proportion to their original concentration) in the tube and allow the unbound reagents to be decanted. After decanting the particles are washed and the enzyme substrate and the chromogen are added. The enzyme-labeled atrazine analog bound to the atrazine antibody catalyzes the conversion of the substrate/chromogen mixture to a colored product. After incubation the reaction is stopped with acid. Since the labeled atrazine was in competition with the unlabled atrazine for the antibody sites, the color developed is inversely proportional to the concentration of atrazine in the sample.

The intensity of the color change is quantified on a spectrophotometer and the concentration reported in micrograms per liter.

While GC analysis detects specific target pesticides individually, ELISA analysis detects a target pesticide and a few additional chemically related compounds. The ELISA triazine analysis is designed to be most sensitive to atrazine, which it measures above a detection limit of 0.046 µg/L, though it also detects simazine (above 0.34 µg/L) and cyanazine (above 1.0 µg/L), according to the manufacturer's literature. The method also detects some degradation products of the pesticides. The ELISA triazine results are therefore the total of triazine herbicides and degradation products in the sample. The other ELISA analyses similarly react to a small group of compounds, but are most sensitive to the targeted pesticide. Detection limits by ELISA analysis, as used by the Kentucky Geological Survey Water Quality Laboratory, are as follows (units are µg/L): triazines, 0.06 (Standard Deviation [SD] 0.08); metolachlor, 0.06 (SD 0.3); 2,4- D, 0.90 (SD 0.16).

Table B-1. Analytical methods, sample containers, preservatives, and maximum holding times.

Metals, Total

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Arsenic	Polyethylene	250 ml	HNO_3, ice	6 months	EPA 200.7A	C
Barium						
Calcium						C, E
Chromium						C
Copper						
Iron						
Lead						
Magnesium						C, E
Manganese						C
Nickel						
Phosphorus						
Potassium						
Silicon						
Sodium						
Strontium						
Sulfur						
Zinc						

Metals, Dissolved

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Arsenic	Polyethylene	250 ml	HNO_3, ice	6 months	EPA 200.7A	C
Barium						
Calcium						
Chromium						
Copper						
Iron						
Lead						
Magnesium						
Manganese						
Nickel						
Phosphorus						
Potassium						
Silicon						
Sodium						
Strontium						
Sulfur						
Zinc						

Table B-1 (Continued)

Nutrients

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Phosphorus-Total	Polyethylene	1 L	H_2SO_4, ice	14 days	Calculated	C
Orthophosphate					EPA 365	
Nitrate-Nitrogen					EPA 300.0	C, B, E
Ammonia-Nitrogen				48 hours	EPA 350.3	C
Kjeldahl-Nitrogen					EPA 351.4	
Nitrite-Nitrogen					EPA 354.1	

Inorganics—Nonmetals

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Bicarbonate	Polyethylene	1 L	Ice only	28 days	Calculated	C
Chloride					EPA 300.0	
Conductance					EPA 120.1	
Fluoride					EPA 340.2	
pH					EPA 150.1	
Sulfate					EPA 300.0	
Total Hardness					Calculated	C, E
Suspended Solids					EPA 160.1	
Dissolved Solids					EPA 160.1	

Pesticides—Gas chromatograph

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Butylate	Amber glass	1 L	Ice only	7 days	EPA 507 & 508	C
Trifluralin						
Atrazine						
Metribuzin						
Alachlor						
Linuron						
Metolachlor						
Pendimethalin						
Simazine						
Malathion						
Chlorpyrifos						
Endosulfan I						
Endosulfan II						
Permethrin						
Diazinon						
Chlorothalonil						
Cyanazine						

Table B-1 (Continued)

Pesticides—Enzyme-linked immunosorbent assay

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Alachlor	Amber glass	250 ml	Ice only	7 days	KGS Water Quality Lab	C, B, E
Metolachlor						
Triazine						
Carbofuran						

Bacteria

Analyte	*Container*	*Volume*	*Preservative*	*Holding Time*	*Analytical Procedure*	*Analysis Suite*
Total coli	Nalgene	500 ml	Ice only	6 hours	SM 17 9222B	T
Fecal coli					SM17 9222D	
Fecal strep					SM17 9230B	

Table B-2. Lower concentration detection limit by gas chromatograph.

Pesticide	*Detection Limit*
Butylate	0.40 µg/L
Trifluralin	0.01 µg/L
Simazine	0.3 µg/L
Atrazine	0.3 µg/L
Metribuzin	0.01 µg/L
Alachlor	0.03 µg/L
Linuron	0.10 µg/L
Malathion	0.05 µg/L
Metolachlor	0.05 µg/L
Chlorpyrifos	0.007 µg/L
Pendimethalin	0.02 µg/L
Endosulfan I	0.02 µg/L
Endosulfan II	0.02 µg/L
Permethrin	0.10 µg/L
Cyanazine	0.50 µg/L

APPENDIX C:
Analyses of Precipitation and Miscellaneous Quality-Assurance/ Quality-Control Samples

Precipitation Samples

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Nitrate (as N)	Deployment Duration
RAIN0001	Jun/4/1992	12:35	< 0.06 µg/L		< 0.07 µg/L	< 0.06 µg/L		1:45 hrs.
RAIN0002	Jul/7/1992	13:43	< 0.06 µg/L	< 0.08 µg/L	< 0.07 µg/L	0.18 µg/L		21 days
RAIN0003	May/19/1992	8:55	0.68 µg/L		< 0.07 µg/L	0.81 µg/L		17 hrs.
RAIN0004	Jun/1/1993	16:43	0.93 µg/L	0.55 µg/L	< 0.07 µg/L	0.35 µg/L		12 days
RAIN0005	Jul/1/1993	8:05	< 0.06 µg/L		< 0.07 µg/L	0.2 µg/L	0.28 mg/L	8 hrs.
RAIN0006	Mar/28/1994	11:40	< 0.07 µg/L		< 0.08 µg/L	< 0.08 µg/L	0.271 mg/L	21:30 hrs.
RAIN0007	Jun/2/1994	11:56	< 0.07 µg/L		< 0.08 µg/L	< 0.08 µg/L	0.926 mg/L	1:15 hrs.

Miscellaneous Samples

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Nitrate (as N)	Deployment Duration
CAWW0001	Apr/28/1994	7:36	1.4 µg/L		< 0.08 µg/L	0.33 µg/L	2.76 mg/L	
CAWW0002	Apr/28/1994	7:36	1.1 µg/L	< 0.1 µg/L	< 0.08 µg/L	0.17 µg/L	2.69 mg/L	
LDWW0001	Jun/26/1991	7:23	2.01 µg/L				6.0 mg/L	
MHWW0001	Jun/24/1993	9:00	3.2 µg/L		< 0.06 µg/L	0.28 µg/L	3.14 mg/L	
MMWW0001	Jul/15/1993	10:50	< 0.06 µg/L		< 0.07 µg/L	< 0.06 µg/L	0.77 mg/L	

Quality-Assurance/Quality-Control Samples

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Nitrate (as N)
LPDP0090	May/12/1994	10:40	1.3 µg/L		< 0.08 µg/L	0.44 µg/L	5.29 mg/L
PGDP0306	Dec/8/1993	9:30	1.2 µg/L		< 0.07 µg/L	< 0.06 µg/L	7.45 mg/L
PGDP0342	Feb/2/1994	12:10	< 0.07 µg/L				7.32 mg/L
PGDP0344	Mar/1/1994	11:00	0.72 µg/L		< 0.08 µg/L	< 0.08 µg/L	6.94 mg/L
PGDP0346	Mar/28/1994	15:57	2.1 µg/L		< 0.08 µg/L	0.28 µg/L	4.97 mg/L
PGDP0385	Apr/7/1994	14:00	1.9 µg/L				6.17 mg/L
PGDP0392	Apr/13/1994	6:15	2.2 µg/L		< 0.08 µg/L	0.24 µg/L	5.58 mg/L
PGDP0412	Apr/27/1994	10:00	1.8 µg/L		< 0.08 µg/L	0.42 µg/L	3.95 mg/L
PGDP0463	Jun/1/1994	12:00	1.0 µg/L		< 0.08 µg/L	< 0.08 µg/L	4.2 mg/L
PGDP0532	Jul/7/1994	7:10	1.1 µg/L				
PGDP0539	Aug/16/1994	10:00	0.72 µg/L			< 0.08 µg/L	4.31 mg/L
PGEB0215	May/4/1993	13:55		< 0.23 µg/L			
PGEB0159	Mar/5/1993	10:00		< 0.018 µg/L			
PGEB0065	Oct/6/1993	12:50		< 0.16 µg/L			
PGEB0343	Feb/22/1994	11:20	< 0.07 µg/L	< 0.19 µg/L	< 0.08 µg/L	< 0.08 µg/L	< 0.1 mg/L
PGEB2901	Mar/2/1994	10:00	< 0.07 µg/L				< 0.1 mg/L
PGEB3701	Mar/2/1994	10:00	< 0.07 µg/L				< 0.1 mg/L
LPEB3702	Mar/2/1994	14:00	< 0.07 µg/L				< 0.1 mg/L
PGEB0364	Mar/28/1994	13:00	< 0.07 µg/L		< 0.08 µg/L	< 0.08 µg/L	< 0.1 mg/L
PGEB0412	Apr/27/1994	10:00	< 0.06 µg/L		< 0.08 µg/L	< 0.08 µg/L	< 0.1 mg/L
PGEB0532	Jul/7/1994	7:10	< 0.07 µg/L				< 0.1 mg/L

Quality-Assurance/Quality-Control Samples (Continued)

Sample Number	*Date*	*Time (CST)*	*Total ELISA Triazines*	*Total GC Atrazine*	*Total ELISA Carbofuran*	*Total ELISA Metolachlor*	*Nitrate (as N)*
FIBK0002	Apr/29/1992	7:33	< 0.06 µg/L	< 0.021 µg/L	< 0.07 µg/L	< 0.04 µg/L	
FIBK0306	Dec/8/1993	9:30	< 0.06 µg/L		< 0.07 µg/L	< 0.06 µg/L	< 0.1 mg/L
FIBK0342	Feb/2/1994	12:10	< 0.07 µg/L				< 0.1 mg/L

Sample Number Explanations
RAIN—Precipitation sample
CAWW—City of Adairville Water Works, Russell Law Oper.
MHWW—Water well; see ID number 17174, Appendix E
MMWW—Water well; see ID number 17155, Appendix E
LDWW—Water well; see ID number 11385, Appendix E
LPDP—Duplicate of LPKW sample
PGDP—Duplicates of PGSP samples
PGEB—Equipment blank collected at PGSP
LPEB—Equipment blank collected at LPKW
FIBK—Field blank

APPENDIX D:
Summary of Ground-Water Dye Traces in the Pleasant Grove Spring Basin Study Area

Adairville Quadrangle

Spring Name: Unknown (probably Masons Spring)

ID Number	*Formation/Member*	*Spring Type*	*Receiving Water Body*	*River Basin*	*Latitude*	*Longitude*	*Elevation*
00013793	St. Louis	Gravity	Little Whippoorwill Ck.	LCR	364325.0	865058.0	530.0
Comments: Detected in Little Whippoorwill Creek at Kentucky Highway 663 bridge, approximately 1.5 miles downstream of Masons Spring, the largest spring known between Hobsons Spring and Kentucky Highway 663.							
Researcher	*Injection Point Name*	*Dye Used*	*Dye Injection*	*Bug Recovery*	*Latitude*	*Longitude*	*Elevation*
JCC DK	Tadpole estavelle	Fluorescein	Jun/13/1991	Jun/19/1991	364455.0	865157.0	585.0

Dennis Quadrangle

Spring Name: Hobsons

ID Number	*Formation/Member*	*Spring Type*	*Receiving Water Body*	*River Basin*	*Latitude*	*Longitude*	*Elevation*
00013161	St. Louis	Rise pool	Little Whippoorwill Ck.	LCR	364507.0	865123.0	570.0
Comments: About 2,000 ft. northeast of intersection U.S. Highway 431 and Kentucky Highway 739.							
Researcher	*Injection Point Name*	*Dye Used*	*Dye Injection*	*Bug Recovery*	*Latitude*	*Longitude*	*Elevation*
JCC CDG	McCaleb karst window	Tinopal CBS-X	Apr/24/1991	Apr/30/1991	364705.0	865145.0	595.0
JCC DG	Scales karst window	Rhodamine WT	Feb/20/1991	Mar/27/1991	364608.0	865130.0	585.0
JCC DK	Greenbriar Cave	Rhodamine WT	Jun/13/1991	Jun/19/1991	364758.0	865111.0	620.0
JCC DK	Crawdad estavelle	Tinopal CBS-X	Jul/11/1991	Aug/21/1991	364719.0	865231.0	615.0
JCC DK	Scales estavelle	Fluorescein	Jul/11/1991	Jul/18/1991	364612.0	865158.0	585.0
DG RM	Unamed sinkhole	Rhodamine WT	Sep/09/1992	Sep/23/1992	364838.0	865231.5	655.0

Dot Quadrangle

Spring Name: Pleasant Grove

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00010795	St. Louis	Rise pool	Pleasant Grove Creek	LCR	364244.0	865419.0	510.0
Comments: Also called Dripping Spring. Perennial discharge from a bedrock cave at 1 to 200 cfs.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC DK	The Canyon	Direct Yellow 96	Apr/18/1991	Apr/23/1991	364451.0	865358.0	550.0
JCC DK	Delaney swallow hole	Rhodamine WT	Apr/18/1991	Apr/23/1991	364425.0	865512.0	540.0
JCC DG	Kemper karst window	Direct Yellow 96	Mar/21/1991	Mar/27/1991	364322.0	865330.0	550.0
JCC DG	Dotson karst window	Fluorescein	Mar/21/1991	Mar/27/1991	364349.0	865441.0	535.0
JCC DK	Harper well	Tinopal CBS-X	Jun/13/1991	Jun/19/1991	364554.0	865333.0	580.0
JCC JA	U. Pleasant Gr. Ck. (UPGC)	Rhodamine WT	Jan/16/1992	Jan/23/1992	364535.0	865450.0	575.0
JCC	Poison Ivy karst window	Fluorescein	Jun/04/1992	Jun/10/1992	364348.0	865242.0	580.0
DG	Harper karst window	Rhodamine WT	Apr/21/1992	May/14/1992	364512.0	865402.5	595.0
JCC EF	Piper estavelle, UPGC	Rhodamine WT	Nov/25/1992	Dec/16/1992	364535.0	865450.0	575.0
JCC DG	Headwaters, UPGC	Rhodamine WT	Jan/21/1993	Feb/03/1993	364713.0	865508.0	595.0
JCC DG	Bob Miller sinkhole	Fluorescein	Jan/20/1993	Jan/28/1993	364435.0	865245.0	585.0
JCC EF	Johnson swallow hole	Rhodamine WT	Mar/24/1993	Apr/01/1993	364305.0	865444.0	520.0
JCC	Wheatfield estavelle	Fluorescein	Apr/22/1993	May/05/1993	364435.0	865337.0	580.0
JCC	Gooch sinkhole	Rhodamine WT	Jan/27/1994	Feb/02/1994	364537.0	865238.0	610.0
JCC	Marvin Dotson sinkhole	Fluorescein	Mar/27/1994	Mar/29/1994	364332.0	865420.0	565.0

Spring Name: Dotson Spring

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013686	St. Louis	Rise pool	Pleasant Grove Creek	LCR	364218.0	865438.0	505.0
Comments: On east bank of Pleasant Grove Creek, west of Stovall Road, and approximately 0.75 mile downstream of Pleasant Grove Spring.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC	Timmie karst window	Direct Yellow 96	Feb/19/1992	Feb/25/1992	364219.0	865418.0	505.0
JCC DG	Travis sinkhole	Fluorescein	Dec/02/1992	Dec/16/1992	364244.0	865234.0	560.0

Spring Name: Campbell bluehole

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013800	St. Louis	Rise pool	Pleasant Grove Creek	LCR	364202.0	865507.0	495.0
Comments: Located 1,000 ft. east of Kentucky Highway 96 and 100 ft. west of Pleasant Grove Creek.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC DK	Richarson karst window	Direct Yellow 96	Jun/13/1991	Jun/19/1991	364207.0	865558.0	535.0
JCC JA	Trailer karst window	Direct Yellow 96	Jan/16/1992	Jan/23/1992	364217.0	865514.0	540.0

Dot Quadrangle (Continued)

Spring Name: Claude Blick

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013802	St. Louis	Gravity	Whippoorwill Creek	LCR	364253.0	865735.0	495.0
Comments: Located 200 ft. west of Kentucky Highway 1041, on east bank of Whippoorwill Creek.							
Researcher	*Injection Point Name*	*Dye Used*	*Dye Injection*	*Bug Recovery*	*Latitude*	*Longitude*	*Elevation*
JCC DK	Roaring well Cave	Rhodamine WT	Jul/11/1991	Jul/18/1991	364258.0	865629.0	540.0

Spring Name: Unknown (probably unnamed spring on Pleasant Grove Creek)

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013161	St. Louis	Gravity	Pleasant Grove Creek	LCR	364217.0	865450.0	505.0
Comments: Detected in Pleasant Grove Creek at Mortimer Road bridge, approximately 1/8 mile downstream of an unnamed spring on the west bank of Pleasant Grove Creek, less than 100 feet west of an abandoned house. The spring is the largest known on the west bank between Pleasant Grove Spring and Mortimer Road.							
Researcher	*Injection Point Name*	*Dye Used*	*Dye Injection*	*Bug Recovery*	*Latitude*	*Longitude*	*Elevation*
JCC EF	Rodgers sinkhole	Fluorescein	Mar/24/1993	Apr/01/1993	364255.0	865509.0	550.0

Russellville Quadrangle

Spring Name: Steve Blick

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013805	Ste. Genevieve	Gravity	Whippoorwill Creek	LCR	364508.0	865859.0	530.0
Comments: Located on east bank of Whippoorwill Creek, northwest of intersection of Kentucky Highway 1309 and Kentucky Highway 775, and about 400 ft. west of Kentucky Highway 1309.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC EF	King Cave	Rhodamine WT	Mar/04/1993	Mar/23/1993	364436.0	865715.0	565.0

Spring Name: Dawson

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013806	Ste. Genevieve	Gravity	Whippoorwill Creek	LCR	364614.0	865814.0	550.0
Comments: Located approximately 2,000 ft. west of Kentucky Highway 1041 on east bank of Whippoorwill Creek.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC DK	Hickory Hill Karst W.	Fluorescein	Apr/18/1991	Apr/23/1991	364528.0	865610.0	575.0
JCC DK	Drinking Cup Cave	Direct Yellow 96	Jul/11/1991	Jul/18/1991	364630.0	865647.0	585.0
JCC DH	Miles karst window	Tinopal CBS-X	Mar/26/1992	Apr/01/1992	364606.0	865602.0	590.0
DG	Shackelford sinkhole	Tinopal CBS-X	Apr/21/1992	Apr/30/1992	364619.0	865500.0	585.0

Spring Name: Spring View

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013809	Ste. Genevieve	Rise Pool	Dry Fork of Whippoorwill Ck.	LCR	364746.0	865830.0	565.0
Comments: Located 400 ft. south of U.S. Highway 79, and flows into Dry Fork.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC JA	Toon Swallow Hole	Direct Yellow 96	Jan/16/1992	Jan/23/1992	364758.0	865658.0	585.0
JCC JA	Wilkins karst window	Fluorescein	Jan/16/1992	Jan/23/1992	364814.0	865415.0	615.0
JCC	Golf Course swallow hole	Rhodamine WT	Feb/19/1992	Feb/25/1992	364855.0	865305.0	645.0
JCC	Sansom estavelle	Tinopal CBS-X	Feb/19/1992	Feb/25/1992	364827.0	865325.0	635.0

Spring Name: Thad Flowers bluehole

ID Number	Formation/Member	Spring Type	Receiving Water Body	River Basin	Latitude	Longitude	Elevation
00013950	Ste. Genevieve	Rise Pool	Upper Pleasant Grove Creek	LCR	364635.0	865348.0	600.0
Comments: An estevelle located 2,000 ft. east of Kentucky Highway 96 in a grove of trees.							
Researcher	Injection Point Name	Dye Used	Dye Injection	Bug Recovery	Latitude	Longitude	Elevation
JCC	Hindman sinkhole	Fluorescein	Feb/16/1993	Mar/03/1993	364653.0	865343.0	610.0

APPENDIX E:
Inventory of Water Wells in the Pleasant Grove Spring Basin

Static Water Levels Measured Between June 2 and September 13, 1993

Well ID Number	Latitude	Longitude	Total Depth	Elevation	Static Water Level
11385	364628.00	865746.00	100.0 ft.	590 ft.	
11485	364220.00	865435.00	37.0 ft.	530 ft.	
11486	364225.00	865432.00	92.2 ft.	530 ft.	23.5 ft.
11487	364225.00	865257.00	135.0 ft.	580 ft.	60.0 ft.
11488	364230.00	865250.00	165.0 ft.	580 ft.	70.0 ft.
11489	364313.00	865330.00	17.7 ft.	560 ft.	17.7 ft.
11490	364315.00	865325.00		570 ft.	
11491	364318.00	865350.00	76.6 ft.	580 ft.	61.8 ft.
11492	364328.00	865405.00	96.9 ft.	575 ft.	59.6 ft.
11493	364340.00	865445.00	91.5 ft.	585 ft.	71.5 ft.
11495	364222.00	865409.00		540 ft.	
11496	364407.00	865432.00		575 ft.	
11497	364433.00	865520.00		580 ft.	
11498	364428.00	865430.00	80.0 ft.	590 ft.	60.0 ft.
11499	364452.00	865408.00	95.5 ft.	600 ft.	72.5 ft.
11500	364430.00	865238.00	46.2 ft.	620 ft.	22.2 ft.
17127	364458.00	865353.00	35.0 ft.	610 ft.	25 ft.
17128	364445.00	865317.00	65.7 ft.	600 ft.	49.2 ft.
17129	364458.00	865402.00		590 ft.	
17151	364515.00	865315.00		600 ft.	
17152	364450.00	865250.00	100.1 ft.	605 ft.	54.3 ft.
17153	364502.00	865236.00	98.0 ft.	620 ft.	80 ft.
17154	364452.00	865232.00		620 ft.	
17155	364500.00	865238.00	94.5 ft.	620 ft.	45 ft.
17156	364508.00	865240.00	31.1 ft.	620 ft.	26.1 ft.
17157	364432.00	865425.00		610 ft.	
17158	364440.00	865228.00	84.2 ft.	620 ft.	60 ft.
17159	364456.00	865228.00		620 ft.	
17160	364448.00	865235.00	33.7 ft.	615 ft.	31.8 ft.
17161	364330.00	865230.00		620 ft.	
17162	364328.00	865215.00		600 ft.	
17163	364305.00	865200.00		610 ft.	
17164	364318.00	865335.00		600 ft.	
17165	364455.00	865328.00	63 ft.	590 ft.	30 ft.
17166	364450.00	865420.00		612 ft.	
17167	364525.00	865425.00		610 ft.	
17168	364520.00	865320.00	75.0 ft.	610 ft.	55 ft.

Well ID Number	*Latitude*	*Longitude*	*Total Depth*	*Elevation*	*Static Water Level*
17169	364250.00	864450.00	65 ft.	560 ft.	60 ft.
17170	364320.00	865340.00	69.5 ft.	560 ft.	36.7 ft.
17171	364553.00	865345.00		640 ft.	
17172	364553.00	865315.00	66.0 ft.	630 ft.	55 ft.
17173	364535.00	865255.00		640 ft.	
17174	364530.00	865250.00	65.0 ft.	620 ft.	
17175	364603.00	865410.00	64.6 ft.	605 ft.	23 ft.
17176	364608.00	865410.00		590 ft.	8.5 ft.
17177	364720.00	865455.00	73.8 ft.	605 ft.	8.5 ft.
17178	364630.00	865400.00	37.5 ft.	610 ft.	24.6 ft.
17179	364718.00	865425.00	104.6 ft.	640 ft.	29.6 ft.
17180	364715.00	865423.00	29.2 ft.	620 ft.	9.2 ft.
17181	364740.00	865345.00	135.0 ft.	650 ft.	
17182	364715.00	865345.00		645 ft.	
17183	364700.00	865445.00		600 ft.	
17184	364738.00	865340.00		650 ft.	
17185	364738.00	865338.00		650 ft.	
17186	364800.00	865400.00		640 ft.	
17187	364740.00	865305.00		650 ft.	
17188	364756.00	865228.00	87.1 ft.	640 ft.	22.2 ft.
17189	364638.00	865258.00	90 ft.	640 ft.	50 ft.
17190	364508.00	865220.00	42.3 ft.	620 ft.	33.3 ft.
17191	364402.00	865228.00	64 ft.	600 ft.	30 ft.
17192	364510.00	865225.00		610 ft.	
17193	364456.00	865215.00		600 ft.	
17194	364455.00	865215.00	44.0 ft.	620 ft.	
17195	364550.00	865154.00		610 ft.	
17196	364615.00	865103.00		600 ft.	
17197	364730.00	865222.00		625 ft.	
17198	364722.00	865238.00	87.8 ft.	630 ft.	31 ft.
17199	364548.00	865156.00		630 ft.	
17200	364450.00	865138.00		600 ft.	
17201	364404.00	865128.00	121.3 ft.	590 ft.	52.5 ft.
17202	364447.00	865127.00	36.0 ft.	587 ft.	30.4 ft.
17203	364412.00	865131.00		595 ft.	
17204	364250.00	865605.00		600 ft.	60 ft.
17205	364250.00	865415.00		550 ft.	
17206	364307.00	865504.00		570 ft.	

Well ID Number	Latitude	Longitude	Total Depth	Elevation	Static Water Level
17207	364314.00	865440.00	90.0 ft.	560 ft.	
17208	364308.00	865442.00		540 ft.	
17209	364326.00	865435.00	85 ft.	580 ft.	75 ft.
17210	364402.00	865504.00	75.0 ft.	560 ft.	49.0 ft.
17211	364330.00	865549.00	60 ft.	590 ft.	40 ft.
17212	364402.00	865639.00	70 ft.	598 ft.	50 ft.
17213	364407.00	865640.00	57.6 ft.	570 ft.	27.3 ft.
17214	364526.00	865547.00	80 ft.	610 ft.	70 ft.
17215	364550.00	865558.00		600 ft.	
17216	364740.00	865510.00		620 ft.	
17217	364650.00	865202.00		640 ft.	
17218	364806.00	865415.00		640 ft.	
17219	364803.00	865409.00	90.8 ft.	635 ft.	12.5 ft.
17220	364719.00	865404.00	76.3 ft.	630 ft.	26.3 ft.
17221	364508.00	865143.00	79.3 ft.	620 ft.	46.0 ft.
17222	364432.00	865202.00		620 ft.	
17223	364510.00	865245.00		620 ft.	
17224	364426.00	865557.00		590 ft.	
17225	364352.00	865434.00		600 ft.	
17226	364549.00	865407.00	140 ft.	620 ft.	2 ft.
17227	364643.00	865427.00	35.7 ft.	610 ft.	29.0 ft.
17228	364635.00	865424.00		600 ft.	
17229	364309.00	865450.00	48.3 ft.	550 ft.	41.8 ft.
17230	364552.00	865322.00		630 ft.	
17231	364617.00	865457.00		615 ft.	
17232	364616.00	865502.00		615 ft.	
17233	364615.00	865457.00		615 ft.	
17234	364514.00	865144.00		620 ft.	
17235	364420.00	865639.00		575 ft.	
17236	364306.00	865553.00		610 ft.	
17239	364827.00	865551.00		640 ft.	
17240	364827.00	865553.00		630 ft.	46.0 ft.
17242	364814.00	865324.00		640 ft.	39.2 ft.

APPENDIX F:
Field Water-Quality Measurements and Descriptive Statistics for the Pleasant Grove Spring Drainage Basin

Pleasant Grove Spring, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
PGSP0001	Aug/02/1990	11:15	6.49 pH	493 µS	14.6°C
PGSP0002	Feb/28/1991	09:55	5.90 pH	349 µS	12.2°C
PGSP0003	May/01/1991	10:10	6.50 pH	418 µS	14.4°C
PGSP0004	May/22/1991	11:30	6.38 pH	390 µS	15.2°C
PGSP0005	Jun/26/1991	09:42	6.19 pH	326 µS	15.3°C
PGSP0006	Jul/25/1991	10:15	6.54 pH	423 µS	15.1°C
PGSP0007	Aug/29/1991	12:30	6.10 pH	356 µS	15.1°C
PGSP0008	Sep/24/1991	09:30	6.60 pH	422 µS	14.6°C
		Average*	6.34 pH	397 µS	14.6°C
		Maximum	6.60 pH	493 µS	15.3°C
		Minimum	5.90 pH	326 µS	12.2°C
		Standard Deviation	.25	53.5	1.0
		Coefficient Variation	.04	.1	.1
Total of 8 observations					

Spring Valley karst window, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
SVKW0001	Aug/02/1990	10:00	6.32 pH	478 µS	14.3°C
SVKW0002	Feb/28/1991	11:00	6.75 pH	349 µS	12.0°C
SVKW0003	May/22/1991	12:17	6.42 pH	384 µS	14.9°C
SVKW0004	Jun/26/1991	11:00	6.50 pH	331 µS	15.2°C
SVKW0005	Jul/25/1991	09:30	6.60 pH	424 µS	14.8°C
SVKW0006	Aug/29/1991	11:35	6.35 pH	349 µS	14.7°C
SVKW0007	Sep/24/1991	08:40	6.60 pH	411 µS	14.4°C
		Average*	6.51 pH	389 µS	14.3°C
		Maximum	6.75 pH	478 µS	15.2°C
		Minimum	6.32 pH	331 µS	12.0°C
		Standard Deviation	.15	52.0	1.1
		Coefficient Variation	.02	.1	.1
Total of 7 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
TCKW0001	Aug/02/1990	09:00	5.97 pH	370 µS	14.1°C
TCKW0002	May/01/1991	08:45	6.30 pH	408 µS	13.6°C
TCKW0003	May/22/1991	09:30	6.40 pH	386 µS	14.4°C
TCKW0004	Jun/26/1991	07:45	6.52 pH	349 µS	14.4°C
TCKW0005	Jul/25/1991	08:24	6.30 pH	405 µS	14.4°C
TCKW0006	Aug/29/1991	10:45	6.38 pH	335 µS	14.5°C
TCKW0007	Sep/24/1991	07:40	6.42 pH	400 µS	14.4°C
		Average*	6.33 pH	379 µS	14.3°C
		Maximum	6.52 pH	408 µS	14.5°C
		Minimum	5.97 pH	335 µS	13.6°C
		Standard Deviation	.17	28.6	.3
		Coefficient Variation	.03	.1	
Total of 7 observations					

Shackelford Spring, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
SKSP0001	Aug/02/1990	07:10	6.10 pH	486 µS	15.9°C
SKSP0002	Feb/28/1991	13:25	6.83 pH	384 µS	12.7°C
SKSP0003	May/01/1991	07:05	6.70 pH	411 µS	12.8°C
SKSP0004	May/22/1991	07:45	6.46 pH	418 µS	13.6°C
SKSP0005	Jul/25/1991	07:20	6.58 pH	428 µS	16.1°C
SKSP0006	Aug/29/1991	10:00	6.54 pH	348 µS	17.3°C
SKSP0007	Sep/24/1991	06:40	6.20 pH	394 µS	17.7°C
		Average*	6.49 pH	410 µS	15.2°C
		Maximum	6.83 pH	486 µS	17.7°C
		Minimum	6.10 pH	348 µS	12.7°C
		Standard Deviation	.26	42.7	2.1
		Coefficient Variation	.04	.1	.1
Total of 7 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
TFBH0001	Feb/28/1991	12:05	6.80 pH	356 µS	13.8°C
TFBH0002	May/01/1991	07:45	6.64 pH	399 µS	13.2°C
TFBH0003	May/22/1991	06:50	6.06 pH	397 µS	13.0°C
TFBH0004	Jun/26/1991	07:15	6.35 pH	386 µS	19.8°C
TFBH0005	Jul/25/1991	11:10	6.92 pH	506 µS	22.6°C
TFBH0006	Aug/29/1991	09:25	6.01 pH	110 µS	23.0°C
		Average*	6.46 pH	359 µS	17.6°C
		Maximum	6.92 pH	506 µS	23.0°C
		Minimum	6.01 pH	110 µS	13.0°C
		Standard Deviation	.38	132.2	4.8
		Coefficient Variation	.06	.4	.3
Total of 6 observations					

George Delaney swallow hole, August 1990–September 1991

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
GDSW0001	May/22/1991	10:30	7.00 pH	432 µS	16.8°C
GDSW0002	Jun/26/1991	08:50	6.70 pH	372 µS	17.3°C
GDSW0003	Jul/25/1991	08:55	7.19 pH	438 µS	20.2°C
		Average*	6.96 pH	414 µS	18.1°C
		Maximum	7.19 pH	438 µS	20.2°C
		Minimum	6.70 pH	372 µS	16.8°C
Total of 3 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
PGSP0009	Oct/22/1991	08:50	6.55 pH	483 µS	14.4°C
PGSP0010	Dec/17/1991	08:06	6.14 pH	438 µS	12.6°C
PGSP0011	Jan/29/1992	11:00	6.56 pH	557 µS	13.2°C
PGSP0012	Feb/26/1992	12:15	6.12 pH	505 µS	13.4°C
PGSP0013	Mar/25/1992	13:20	7.04 pH	334 µS	13.4°C
PGSP0014	Apr/01/1992	16:16	6.96 pH	295 µS	13.9°C
PGSP0015	Apr/09/1992	15:28	6.96 pH	304 µS	14.5°C
PGSP0021	Apr/29/1992	09:40	7.23 pH		15.7°C
PGSP0026	May/27/1992	10:45	7.12 pH	325 µS	14.5°C
PGSP0027	Jun/03/1992	15:45	7.19 pH	412 µS	14.3°C
PGSP0052	Jun/04/1992	17:15	7.09 pH	316 µS	14.7°C
PGSP0053	Jun/10/1992	13:20	7.21 pH	400 µS	14.7°C
PGSP0054	Jun/18/1992	09:30	7.07 pH	352 µS	14.9°C
PGSP0062	Aug/26/1992	11:30	7.04 pH	365 µS	15.3°C
		Average*	6.88 pH	391 µS	14.3°C
		Maximum	7.23 pH	557 µS	15.7°C
		Minimum	6.12 pH	295 µS	12.6°C
		Standard Deviation	.38	83.6	.9
		Coefficient Variation	.06	.2	.1
Total of 14 observations					

Spring Valley karst window, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
SVKW0008	Oct/22/1991	08:00	6.33 pH	483 µS	14.2°C
SVKW0009	Jan/29/1992	10:00	6.09 pH	555 µS	13.3°C
SVKW0010	Feb/26/1992	11:00	6.76 pH	505 µS	13.3°C
SVKW0011	Mar/25/1992	10:55	6.93 pH	351 µS	13.3°C
SVKW0013	Apr/29/1992	08:40	7.10 pH		16.0°C
SVKW0014	May/27/1992	09:15	7.16 pH	300 µS	18.1°C
		Average*	6.73 pH	439 µS	14.7°C
		Maximum	7.16 pH	555 µS	18.1°C
		Minimum	6.09 pH	300 µS	13.3°C
		Standard Deviation	.43	108.2	2.0
		Coefficient Variation	.06	.2	.1
Total of 6 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
TCKW0008	Dec/17/1991	11:30	6.36 pH	462 µS	13.2°C
TCKW0009	Jan/29/1992	08:30	6.01 pH	559 µS	14.0°C
TCKW0010	Feb/26/1992	09:45	6.56 pH	508 µS	14.1°C
TCKW0011	Mar/25/1992	12:00	6.99 pH	356 µS	14.1°C
TCKW0013	Apr/29/1992	07:40	7.04 pH		14.6°C
TCKW0014	May/27/1992	10:05	6.92 pH	310 µS	17.6°C
		Average*	6.65 pH	439 µS	14.6°C
		Maximum	7.04 pH	559 µS	17.6°C
		Minimum	6.01 pH	310 µS	13.2°C
		Standard Deviation	.41	103.9	1.5
		Coefficient Variation	.06	.2	.1
Total of 6 observations					

Shackelford Spring, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
SKSP0008	Oct/22/1991	06:34	6.24 pH	473 µS	17.3°C
SKSP0009	Dec/17/1991	12:00	6.15 pH	492 µS	14.5°C
SKSP0010	Jan/29/1992	14:30	6.37 pH	534 µS	13.0°C
SKSP0011	Feb/26/1992	08:40	5.37 pH	465 µS	12.0°C
SKSP0012	Mar/25/1992	08:40	7.10 pH	413 µS	12.4°C
SKSP0013	Apr/29/1992	06:43	7.25 pH		12.6°C
SKSP0014	May/27/1992	11:50	7.16 pH	280 µS	16.5°C
		Average*	6.52 pH	443 µS	14.0°C
		Maximum	7.25 pH	534 µS	17.3°C
		Minimum	5.37 pH	280 µS	12.0°C
		Standard Deviation	.69	88.9	2.1
		Coefficient Variation	.11	.2	.2
Total of 7 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
TFBH0007	Dec/17/1991	13:30	6.24 pH	446 µS	14.4°C
TFBH0008	Jan/29/1992	07:50	6.81 pH	440 µS	6.5°C
TFBH0009	Feb/26/1992	07:30	6.86 pH	342 µS	7.5°C
TFBH0010	Mar/25/1992	07:20	7.30 pH	337 µS	13.0°C
		Average*	6.80 pH	391 µS	10.4°C
		Maximum	7.30 pH	446 µS	14.4°C
		Minimum	6.24 pH	337 µS	6.5°C
		Standard Deviation	.43	59.8	3.9
		Coefficient Variation	.06	.2	.4
Total of 4 observations					

George Delaney swallow hole, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
GDSW0004	Dec/17/1991	10:00	6.83 pH	408 µS	9.8°C
GDSW0005	Jan/29/1992	09:10	6.91 pH	469 µS	7.9°C
GDSW0006	Feb/26/1992	10:20	7.42 pH	415 µS	7.8°C
GDSW0007	Mar/25/1992	09:45	7.71 pH	389 µS	10.7°C
		Average*	7.22 pH	420 µS	9.1°C
		Maximum	7.71 pH	469 µS	10.7°C
		Minimum	6.83 pH	389 µS	7.8°C
		Standard Deviation	.42	34.3	1.4
		Coefficient Variation	.06	.1	.2
Total of 4 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
PGSP0065	Oct/06/1992	12:50	7.14 pH	382 µS	16.1°C
PGSP0067	Nov/06/1992	09:00	6.93 pH	643 µS	14.3°C
PGSP0070	Dec/03/1992	09:07	7.43 pH	709 µS	14.1°C
PGSP0071	Jan/08/1993	10:19	6.62 pH	481 µS	13.0°C
PGSP0108	Feb/04/1993	10:00	7.40 pH	536 µS	13.0°C
PGSP0159	Mar/05/1993	10:00	7.20 pH	250 µS	12.2°C
PGSP0211	Apr/07/1993	08:22	7.18 pH	468 µS	14.1°C
PGSP0215	May/04/1993	13:55	6.87 pH	226 µS	14.7°C
PGSP0255	May/20/1993	09:42	7.23 pH	744 µS	14.5°C
PGSP0264	Jun/02/1993	14:30	7.26 pH	420 µS	14.7°C
PGSP0299	Aug/04/1993	09:00	7.16 pH	642 µS	14.6°C
PGSP0302	Sep/09/1993	07:30	7.24 pH	484 µS	14.8°C
		Average*	7.14 pH	499 µS	14.2°C
		Maximum	7.43 pH	744 µS	16.1°C
		Minimum	6.62 pH	226 µS	12.2°C
		Standard Deviation	.23	166.4	1.0
		Coefficient Variation	.03	.3	.1
Total of 12 observations					

Spring Valley karst window, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
SVKW0015	May/20/1993	09:20	7.20 pH	565 µS	14.7°C
SVKW0017	Jun/02/1993	12:55	7.25 pH	337 µS	14.6°C
		Average*	7.23 pH	451 µS	14.7°C
Total of 2 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

George Delaney swallow hole, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
GDSW0009	May/20/1993	08:14	7.00 pH	533 µS	14.5°C
GDSW010A	Jun/03/1993	08:45	7.78 pH	431 µS	16.2°C
		Average*	7.39 pH	482 µS	15.4°C
Total of 2 observations					

Leslie Page karst window, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
LPKW0009	May/20/1993	11:10	7.60 pH	157 µS	13.9°C
LPKW010A	Jun/02/1993	16:50	7.40 pH	208 µS	14.7°C
LPKW0014	Jun/30/1993	09:45	7.65 pH	229 µS	15.9°C
		Average*	7.56 pH	180 µS	14.6°C
		Maximum	7.65 pH	229 µS	15.9°C
		Minimum	7.40 pH	125 µS	13.9°C
		Standard Deviation	.11	47.4	.9
		Coefficient Variation	.01	.3	.1
Total of 3 observations					

Upper Pleasant Grove Creek, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
UPGC0002	Jun/30/1993	09:10	7.65 pH	387 µS	21.4°C
UPGC0003	Aug/03/1993	15:33	8.52 pH	414 µS	28.2°C
		Average*	8.09 pH	401 µS	24.8°C
Total of 2 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
PGSP0303	Oct/06/1993	07:30	7.13 pH	421 µS	14.4°C
PGSP0304	Nov/09/1993	10:45	7.36 pH	347 µS	14.0°C
PGSP0334	Jan/12/1994	11:40	7.11 pH	390 µS	12.1°C
PGSP0342	Feb/02/1994	12:10	7.13 pH	237 µS	11.8°C
PGSP0343	Feb/22/1994	11:20	7.00 pH	202 µS	13.0°C
PGSP0344	Mar/01/1994	11:00	7.45 pH	136 µS	12.7°C
PGSP0364	Mar/28/1994	13:00	7.01 pH	200 µS	12.3°C
PGSP	Apr/20/1994	11:15	7.10 pH	173 µS	14.4°C
PGSP0410	Apr/26/1994	06:00	7.21 pH	374 µS	15.0°C
PGSP0412	Apr/27/1994	10:00	7.25 pH	356 µS	15.6°C
PGSP0413	Apr/28/1994	06:00	7.23 pH	352 µS	15.8°C
PGSP0449	May/12/1994	09:00	7.19 pH	392 µS	14.5°C
PGSP	May/17/1994	13:57	7.13 pH	417 µS	16.5°C
PGSP0463	Jun/01/1994	12:00	7.23 pH	423 µS	14.3°C
PGSP0529	Jul/06/1994	10:30		350 µS	
PGSP0538	Aug/03/1994	08:30	6.93 pH	360 µS	14.5°C
		Average*	7.16 pH	321 µS	14.1°C
		Maximum	7.45 pH	423 µS	16.5°C
		Minimum	6.93 pH	136 µS	11.8°C
		Standard Deviation	.13	96.4	1.4
		Coefficient Variation	.02	.3	.1
Total of 16 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

George Delaney swallow hole, October 1993–September 1994

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
GDSW0013	Mar/28/1994	10:40		190 µS	10.1°C
GDSW0015	Apr/20/1994	12:10	7.80 pH	191 µS	16.1°C
GDSW0016	Apr/26/1994	15:30	8.14 pH	376 µS	19.3°C
GDSW0017	May/12/1994	09:50	7.90 pH	408 µS	15.0°C
GDSW0018	May/17/1994	13:28	7.92 pH	426 µS	18.0°C
GDSW0019	Jun/01/1994	07:36	7.65 pH	406 µS	16.1°C
GDSW0021	Jul/06/1994	09:45		400 µS	
		Average*	7.88 pH	342 µS	15.8°C
		Maximum	8.14 pH	426 µS	19.3°C
		Minimum	7.65 pH	190 µS	10.1°C
		Standard Deviation	.18	104.8	3.2
		Coefficient Variation	.02	.3	.2
Total of 7 observations					

Leslie Page karst window, October 1993–September 1994

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
LPKW0019	Oct/05/1993	13:20	7.70 pH	167 µS	15.1°C
LPKW0020	Nov/09/1993	09:35	7.75 pH	121 µS	12.5°C
LPKW0022	Jan/11/1994	14:23	6.70 pH	124 µS	14.1°C
LPKW0023	Feb/02/1994	09:55	6.92 pH	20 µS	12.5°C
LPKW0024	Feb/22/1994	13:30	6.21 pH	40 µS	14.0°C
LPKW0080	Apr/27/1994	08:31	6.94 pH	219 µS	14.0°C
LPKW0090	May/12/1994	10:40	6.53 pH	176 µS	14.0°C
LPKW	May/17/1994	12:48	7.05 pH	198 µS	16.5°C
LPKW0104	Jun/01/1994	08:30	6.62 pH	241 µS	13.8°C
LPKW0106	Jun/27/1994	23:50		230 µS	
LPKW0109	Aug/02/1994	14:20	6.41 pH	209 µS	14.9°C
		Average*	6.88 pH	159 µS	14.1°C
		Maximum	7.75 pH	241 µS	16.5°C
		Minimum	6.21 pH	20 µS	12.5°C
		Standard Deviation	.51	74.8	1.2
		Coefficient Variation	.07	.5	.1
Total of 11 observations					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Upper Pleasant Grove Creek, October 1993–September 1994

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
UPGC0006	Feb/22/1994	15:16	7.50 pH	162 µS	11.0°C
UPGC0007	Mar/28/1994	11:05		185 µS	11.5°C
UPGC0009	Apr/20/1994	12:25	7.88 pH	175 µS	19.5°C
UPGC0010	Apr/27/1994	07:10	7.63 pH	380 µS	15.8°C
UPGC0011	May/12/1994	10:10	7.84 pH	408 µS	17.0°C
UPGC0012	May/17/1994	12:13	8.03 pH	416 µS	22.0°C
UPGC0013	Jun/01/1994	07:07	7.77 pH	437 µS	15.1°C
UPGC0015	Jul/06/1994	07:30		365 µS	
		Average*	7.78 pH	316 µS	16.0°C
		Maximum	8.03 pH	437 µS	22.0°C
		Minimum	7.50 pH	162 µS	11.0°C
		Standard Deviation	.19	119.7	4.0
		Coefficient Variation	.02	.4	.2
Total of 8 observations					

Miller Schoolhouse water well, October 1993–September 1994

Sample Number	*Date*	*Time (CST)*	*Field pH*	*Field Specific Conductance (25°C)*	*Water Temperature*
MSHW0001	Apr/26/1994	14:00	7.43 pH	615 µS	15.5°C
Total of 1 observation					

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

APPENDIX G:
Water Sample Analyses and Descriptive Statistics for the Pleasant Grove Spring Drainage Basin

Pleasant Grove Spring, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0001	Aug/02/1990	11:15	4.10 mg/L				
PGSP0002	Feb/28/1991	09:55	4.50 mg/L	< 0.01 mg/L	0.080 mg/L	0.030 mg/L	0.010 mg/L
PGSP0003	May/01/1991	10:10	4.80 mg/L	0.011 mg/L	0.080 mg/L	0.030 mg/L	0.020 mg/L
PGSP0004	May/22/1991	11:30	4.30 mg/L	0.036 mg/L	0.040 mg/L	0.030 mg/L	0.048 mg/L
PGSP0005	Jun/26/1991	09:42	4.20 mg/L	0.006 mg/L	0.030 mg/L	0.030 mg/L	0.048 mg/L
PGSP0006	Jul/25/1991	10:15	4.20 mg/L	0.003 mg/L	0.030 mg/L	0.030 mg/L	0.050 mg/L
PGSP0007	Aug/29/1991	12:30	3.82 mg/L	0.003 mg/L	0.020 mg/L	0.030 mg/L	0.040 mg/L
PGSP0008	Sep/24/1991	09:30	3.57 mg/L				0.048 mg/L
		Average*	4.19 mg/L	0.012 mg/L	0.047 mg/L	0.030 mg/L	0.038 mg/L
		Maximum	4.80 mg/L	0.036 mg/L	0.080 mg/L	0.030 mg/L	0.050 mg/L
		Minimum	3.57 mg/L	0.003 mg/L	0.020 mg/L	0.030 mg/L	0.050 mg/L
		Standard Deviation	.38	0.011	.027		.016
		Coefficient Variation	.09	0.917	.570		.427
Number of analyses 8							

Spring Valley karst window, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
SVKW0001	Aug/02/1990	10:00	4.10 mg/L				
SVKW0002	Feb/28/1991	11:00	4.70 mg/L	< 0.01 mg/L	0.120 mg/L	0.030 mg/L	0.010 mg/L
SVKW0003	May/22/1991	12:17	4.50 mg/L	0.031 mg/L	0.030 mg/L	0.030 mg/L	0.053 mg/L
SVKW0004	Jun/26/1991	11:00	4.20 mg/L	0.005 mg/L	0.050 mg/L	0.030 mg/L	0.046 mg/L
SVKW0005	Jul/25/1991	09:30	4.20 mg/L	0.006 mg/L	0.030 mg/L	0.030 mg/L	0.066 mg/L
SVKW0006	Aug/29/1991	11:35	3.80 mg/L	0.003 mg/L	0.010 mg/L	0.030 mg/L	0.045 mg/L
SVKW0007	Sep/24/1991	08:40	3.57 mg/L				0.043 mg/L
		Average*	4.15 mg/L	0.011 mg/L	0.048 mg/L	0.030 mg/L	0.044 mg/L
		Maximum	4.70 mg/L	0.031 mg/L	0.120 mg/L	0.030 mg/L	0.066 mg/L
		Minimum	3.57 mg/L	0.003 mg/L	0.010 mg/L	0.030 mg/L	0.066 mg/L
		Standard Deviation	.39	0.010	.043		.019
		Coefficient Variation	.09	0.932	.889		.424
Number of analyses 7							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
TCKW0001	Aug/02/1990	09:00	3.90 mg/L				
TCKW0002	May/01/1991	08:45	3.50 mg/L	0.005 mg/L	0.010 mg/L	0.030 mg/L	0.029 mg/L
TCKW0003	May/22/1991	09:30	2.70 mg/L	0.008 mg/L	0.040 mg/L	0.030 mg/L	0.049 mg/L
TCKW0004	Jun/26/1991	07:45	3.70 mg/L	0.003 mg/L	0.030 mg/L	0.030 mg/L	0.032 mg/L
TCKW0005	Jul/25/1991	08:24	3.90 mg/L	0.004 mg/L	0.030 mg/L	0.030 mg/L	0.046 mg/L
TCKW0006	Aug/29/1991	10:45	3.62 mg/L	0.004 mg/L	0.030 mg/L	0.030 mg/L	0.042 mg/L
TCKW0007	Sep/24/1991	07:40	3.46 mg/L				0.046 mg/L
		Average*	3.54 mg/L	0.005 mg/L	0.028 mg/L	0.030 mg/L	0.041 mg/L
		Maximum	3.90 mg/L	0.008 mg/L	0.040 mg/L	0.030 mg/L	0.049 mg/L
		Minimum	2.70 mg/L	0.003 mg/L	0.010 mg/L	0.030 mg/L	0.049 mg/L
		Standard Deviation	.41	0.002	.011		.008
		Coefficient Variation	.12	0.344	.391		.203
Number of analyses 7							

Shackelford Spring, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
SKSP0001	Aug/02/1990	07:10	7.10 mg/L				
SKSP0002	Feb/28/1991	13:25	7.00 mg/L	< 0.01 mg/L	0.090 mg/L	0.030 mg/L	0.010 mg/L
SKSP0003	May/01/1991	07:05	7.60 mg/L	0.004 mg/L	0.090 mg/L	0.030 mg/L	0.024 mg/L
SKSP0004	May/22/1991	07:45	7.40 mg/L	0.006 mg/L	0.040 mg/L	0.030 mg/L	0.038 mg/L
SKSP0005	Jul/25/1991	07:20	8.20 mg/L	0.002 mg/L	0.060 mg/L	0.030 mg/L	0.055 mg/L
SKSP0006	Aug/29/1991	10:00	7.04 mg/L	0.003 mg/L	0.010 mg/L	0.030 mg/L	0.058 mg/L
SKSP0007	Sep/24/1991	06:40	6.43 mg/L				0.057 mg/L
		Average*	7.25 mg/L	0.005 mg/L	0.058 mg/L	0.030 mg/L	0.040 mg/L
		Maximum	8.20 mg/L	0.006 mg/L	0.090 mg/L	0.030 mg/L	0.058 mg/L
		Minimum	6.43 mg/L	0.002 mg/L	0.010 mg/L	0.030 mg/L	0.058 mg/L
		Standard Deviation	.56	0.003	.034		.020
		Coefficient Variation	.08	0.566	.590		.496
Number of analyses 7							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
TFBH0001	Feb/28/1991	12:05	6.40 mg/L		0.050 mg/L	0.030 mg/L	0.010 mg/L
TFBH0002	May/01/1991	07:45	7.00 mg/L	0.013 mg/L	0.050 mg/L	0.030 mg/L	0.008 mg/L
TFBH0003	May/22/1991	06:50	6.80 mg/L	0.010 mg/L	0.070 mg/L	0.300 mg/L	0.024 mg/L
TFBH0004	Jun/26/1991	07:15	4.60 mg/L	0.426 mg/L	0.300 mg/L	0.030 mg/L	0.049 mg/L
TFBH0005	Jul/25/1991	11:10	0.02 mg/L	0.007 mg/L	4.460 mg/L	0.090 mg/L	0.062 mg/L
TFBH0006	Aug/29/1991	09:25	1.04 mg/L	0.208 mg/L	1.020 mg/L	0.030 mg/L	0.477 mg/L
		Average*	4.31 mg/L	0.133 mg/L	0.992 mg/L	0.085 mg/L	0.105 mg/L
		Maximum	7.00 mg/L	0.426 mg/L	4.460 mg/L	0.300 mg/L	0.477 mg/L
		Minimum	.02 mg/L	0.007 mg/L	0.050 mg/L	0.030 mg/L	0.477 mg/L
		Standard Deviation	3.06	0.165	1.740	.108	.184
		Coefficient Variation	.71	1.244	1.754	1.271	1.748
Number of analyses 6							

George Delaney swallow hole, August 1990–September 1991

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrite (mg/L as NO_2)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
GDSW0001	May/22/1991	10:30	6.70 mg/L	0.058 mg/L	0.050 mg/L	0.030 mg/L	0.040 mg/L
GDSW0002	Jun/26/1991	08:50	5.70 mg/L	0.034 mg/L	0.050 mg/L	0.030 mg/L	0.033 mg/L
GDSW0003	Jul/25/1991	08:55	4.30 mg/L	0.171 mg/L	0.120 mg/L	0.030 mg/L	0.074 mg/L
		Average*	5.57 mg/L	0.088 mg/L	0.073 mg/L	0.030 mg/L	0.049 mg/L
		Maximum	6.70 mg/L	0.171 mg/L	0.120 mg/L	0.030 mg/L	0.074 mg/L
		Minimum	4.30 mg/L	0.034 mg/L	0.050 mg/L	0.030 mg/L	0.074 mg/L
Number of analyses 3							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, August 1990–September 1991

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0001	7.16 SU	468 µS	219.00 mg/L	278 mg/L	5 mg/L	0.106 mg/L
PGSP0002	7.02 SU	363 µS	150.00 mg/L	194 mg/L	26 mg/L	0.688 mg/L
PGSP0003	7.15 SU	397 µS	174.00 mg/L	256 mg/L	9 mg/L	0.128 mg/L
PGSP0004	7.08 SU	365 µS	160.00 mg/L	254 mg/L	33 mg/L	0.772 mg/L
PGSP0005	6.98 SU	357 µS	154.00 mg/L	230 mg/L	18 mg/L	1.230 mg/L
PGSP0006	6.71 SU	440 µS	200.00 mg/L	238 mg/L	8 mg/L	0.213 mg/L
PGSP0007	6.48 SU	481 µS	224.00 mg/L	310 mg/L	3 mg/L	0.058 mg/L
PGSP0008	6.93 SU	489 µS	232.00 mg/L	308 mg/L	4 mg/L	0.046 mg/L
Average*	6.94 SU	420 µS	189.13 mg/L	259 mg/L	13.25 mg/L	0.405 mg/L
Maximum	7.16 SU	489 µS	232.00 mg/L	310 mg/L	33.00 mg/L	1.230 mg/L
Minimum	6.48 SU	357 µS	150.00 mg/L	194 mg/L	3.00 mg/L	0.046 mg/L
Standard Deviation	.23	56.0	33.61	39.5	11.21	.439
Coefficient Variation	.03	.1	.18	.2	.85	1.083
Number of analyses 8						

Spring Valley karst window, August 1990–September 1991

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
SVKW0001	7.12 SU	466 µS	218.00 mg/L	283 mg/L	4 mg/L	0.134 mg/L
SVKW0002	7.08 SU	362 µS	150.00 mg/L	194 mg/L	32 mg/L	0.778 mg/L
SVKW0003	7.18 SU	369 µS	162.00 mg/L	252 mg/L	40 mg/L	1.100 mg/L
SVKW0004	7.10 SU	359 µS	156.00 mg/L	232 mg/L	16 mg/L	0.788 mg/L
SVKW0005	6.73 SU	441 µS	199.00 mg/L	250 mg/L	8 mg/L	0.279 mg/L
SVKW0006	6.55 SU	479 µS	222.00 mg/L	306 mg/L	5 mg/L	0.384 mg/L
SVKW0007	6.93 SU	489 µS	231.00 mg/L	284 mg/L	5 mg/L	0.194 mg/L
Average*	6.96 SU	424 µS	191.14 mg/L	257 mg/L	15.71 mg/L	0.522 mg/L
Maximum	7.18 SU	489 µS	231.00 mg/L	306 mg/L	40.00 mg/L	1.100 mg/L
Minimum	6.55 SU	359 µS	150.00 mg/L	194 mg/L	4.00 mg/L	0.134 mg/L
Standard Deviation	.23	58.3	34.40	37.6	14.61	.367
Coefficient Variation	.03	.1	.18	.1	.93	.702
Number of analyses 7						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, August 1990–September 1991

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
TCKW0001	7.11 SU	450 µS	212.00 mg/L	276 mg/L	16 mg/L	0.558 mg/L
TCKW0002	7.00 SU	395 µS	179.00 mg/L	222 mg/L	34 mg/L	0.424 mg/L
TCKW0003	6.99 SU	367 µS	168.00 mg/L	214 mg/L	94 mg/L	2.650 mg/L
TCKW0004	7.00 SU	387 µS	174.00 mg/L	250 mg/L	23 mg/L	0.692 mg/L
TCKW0005	6.71 SU	427 µS	194.00 mg/L	238 mg/L	24 mg/L	0.600 mg/L
TCKW0006	6.62 SU	458 µS	213.00 mg/L	296 mg/L	26 mg/L	0.750 mg/L
TCKW0007	7.03 SU	467 µS	221.00 mg/L	276 mg/L	56 mg/L	2.430 mg/L
Average*	6.92 SU	422 µS	194.43 mg/L	253 mg/L	39.00 mg/L	1.158 mg/L
Maximum	7.11 SU	467 µS	221.00 mg/L	296 mg/L	94.00 mg/L	2.650 mg/L
Minimum	6.62 SU	367 µS	168.00 mg/L	214 mg/L	16.00 mg/L	0.424 mg/L
Standard Deviation	.18	39.0	21.27	30.6	27.44	.952
Coefficient Variation	.03	.1	.11	.1	.70	.822
Number of analyses 7						

Shackelford Spring, August 1990–September 1991

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
SKSP0001	7.20 SU	443 µS	212.00 mg/L	299 mg/L	4 mg/L	0.147 mg/L
SKSP0002	6.98 SU	392 µS	150.00 mg/L	212 mg/L	8 mg/L	0.118 mg/L
SKSP0003	7.09 SU	407 µS	163.00 mg/L	264 mg/L	6 mg/L	0.123 mg/L
SKSP0004	7.16 SU	406 µS	162.00 mg/L	316 mg/L	40 mg/L	0.012 mg/L
SKSP0005	6.88 SU	433 µS	168.00 mg/L	296 mg/L	7 mg/L	0.303 mg/L
SKSP0006	6.66 SU	444 µS	178.00 mg/L	298 mg/L	5 mg/L	1.040 mg/L
SKSP0007	7.08 SU	444 µS	184.00 mg/L	270 mg/L	27 mg/L	0.388 mg/L
Average*	7.01 SU	424 µS	173.86 mg/L	279 mg/L	13.86 mg/L	0.304 mg/L
Maximum	7.20 SU	444 µS	212.00 mg/L	316 mg/L	40.00 mg/L	1.040 mg/L
Minimum	6.66 SU	392 µS	150.00 mg/L	212 mg/L	4.00 mg/L	0.012 mg/L
Standard Deviation	.19	21.9	20.15	34.7	13.99	.348
Coefficient Variation	.03	.1	.12	.1	1.01	1.143
Number of analyses 7						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, August 1990–September 1991

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
TFBH0001	6.92 SU	360 µS	129.00 mg/L	202 mg/L	3 mg/L	0.014 mg/L
TFBH0002	7.15 SU	390 µS	154.00 mg/L	268 mg/L	3 mg/L	0.028 mg/L
TFBH0003	7.02 SU	382 µS	150.00 mg/L	304 mg/L	4 mg/L	0.126 mg/L
TFBH0004	7.04 SU	372 µS	151.00 mg/L	260 mg/L	6 mg/L	0.123 mg/L
TFBH0005	7.12 SU	437 µS	203.00 mg/L	232 mg/L	8 mg/L	1.010 mg/L
TFBH0006	6.33 SU	121 µS	37.00 mg/L	164 mg/L	420 mg/L	
Average*	6.93 SU	344 µS	137.33 mg/L	238 mg/L	74.00 mg/L	0.260 mg/L
Maximum	7.15 SU	437 µS	203.00 mg/L	304 mg/L	420.00 mg/L	1.010 mg/L
Minimum	6.33 SU	121 µS	37.00 mg/L	164 mg/L	3.00 mg/L	0.014 mg/L
Standard Deviation	.30	112.2	54.91	50.1	169.52	.422
Coefficient Variation	.04	.3	.40	.2	2.29	1.623
Number of analyses 6						

George Delaney swallow hole, August 1990–September 1991

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
GDSW0001	7.60 SU	385 µS	154.00 mg/L	308 mg/L	16 mg/L	0.146 mg/L
GDSW0002	7.02 SU	381 µS	157.00 mg/L	244 mg/L	14 mg/L	0.375 mg/L
GDSW0003	7.48 SU	411 µS	177.00 mg/L	268 mg/L	36 mg/L	1.390 mg/L
Average*	7.37 SU	392 µS	162.67 mg/L	273 mg/L	22.00 mg/L	0.637 mg/L
Maximum	7.60 SU	411 µS	177.00 mg/L	308 mg/L	36.00 mg/L	1.390 mg/L
Minimum	7.02 SU	381 µS	154.00 mg/L	244 mg/L	14.00 mg/L	0.146 mg/L
Number of analyses 3						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, August 1990–September 1991

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
PGSP0001	78.10 mg/L	7.59 mg/L	2.18 mg/L	1.32 mg/L	267 mg/L	5.48 mg/L	5.01 mg/L
PGSP0002	62.90 mg/L	5.57 mg/L	2.08 mg/L	1.66 mg/L	183 mg/L	5.00 mg/L	6.13 mg/L
PGSP0003	68.20 mg/L	6.15 mg/L	2.21 mg/L	1.12 mg/L	212 mg/L	10.90 mg/L	5.86 mg/L
PGSP0004	65.60 mg/L	5.93 mg/L	2.11 mg/L	1.26 mg/L	195 mg/L	5.62 mg/L	5.18 mg/L
PGSP0005	64.30 mg/L	5.98 mg/L	1.89 mg/L	1.91 mg/L	188 mg/L	5.00 mg/L	5.00 mg/L
PGSP0006	76.60 mg/L	7.40 mg/L	2.18 mg/L	1.17 mg/L	244 mg/L	5.40 mg/L	5.28 mg/L
PGSP0007	88.00 mg/L	8.46 mg/L	2.26 mg/L	1.15 mg/L	273 mg/L	7.53 mg/L	4.65 mg/L
PGSP0008	85.90 mg/L	8.37 mg/L	2.17 mg/L	1.22 mg/L	283 mg/L	5.82 mg/L	4.33 mg/L
Average*	73.70 mg/L	6.93 mg/L	2.14 mg/L	1.35 mg/L	230.63 mg/L	6.34 mg/L	5.18 mg/L
Maximum	88.00 mg/L	8.46 mg/L	2.26 mg/L	1.91 mg/L	283.00 mg/L	10.90 mg/L	6.13 mg/L
Minimum	62.90 mg/L	5.57 mg/L	1.89 mg/L	1.12 mg/L	183.00 mg/L	5.00 mg/L	4.33 mg/L
Standard Deviation	9.87	1.16	.11	.28	40.96	2.01	.59
Coefficient Variation	.13	.17	.05	.21	.18	.32	.11
Number of analyses 8							

Spring Valley karst window, August 1990–September 1991

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
SVKW0001	80.10 mg/L	7.99 mg/L	2.25 mg/L	1.32 mg/L	266 mg/L	5.50 mg/L	4.88 mg/L
SVKW0002	63.50 mg/L	5.68 mg/L	2.10 mg/L	1.43 mg/L	183 mg/L	5.00 mg/L	5.94 mg/L
SVKW0003	66.70 mg/L	6.07 mg/L	2.14 mg/L	1.07 mg/L	198 mg/L	5.46 mg/L	5.34 mg/L
SVKW0004	64.40 mg/L	6.05 mg/L	1.95 mg/L	1.51 mg/L	190 mg/L	5.00 mg/L	5.12 mg/L
SVKW0005	77.40 mg/L	7.54 mg/L	2.17 mg/L	1.27 mg/L	243 mg/L	5.06 mg/L	5.17 mg/L
SVKW0006	85.70 mg/L	8.50 mg/L	2.20 mg/L	1.11 mg/L	271 mg/L	5.00 mg/L	4.62 mg/L
SVKW0007	84.00 mg/L	8.44 mg/L	2.15 mg/L	1.38 mg/L	282 mg/L	5.84 mg/L	4.15 mg/L
Average*	74.54 mg/L	7.18 mg/L	2.14 mg/L	1.30 mg/L	233.29 mg/L	5.27 mg/L	5.03 mg/L
Maximum	85.70 mg/L	8.50 mg/L	2.25 mg/L	1.51 mg/L	282.00 mg/L	5.84 mg/L	5.94 mg/L
Minimum	63.50 mg/L	5.68 mg/L	1.95 mg/L	1.07 mg/L	183.00 mg/L	5.00 mg/L	4.15 mg/L
Standard Deviation	9.48	1.22	.10	.16	42.05	.34	.57
Coefficient Variation	.13	.17	.04	.12	.18	.06	.11
Number of analyses 7							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, August 1990–September 1991

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
TCKW0001	78.70 mg/L	7.49 mg/L	2.19 mg/L	1.32 mg/L	258 mg/L	0.00 mg/L	4.26 mg/L
TCKW0002	70.70 mg/L	6.06 mg/L	1.98 mg/L	1.15 mg/L	218 mg/L	9.06 mg/L	4.82 mg/L
TCKW0003	67.50 mg/L	6.51 mg/L	1.95 mg/L	1.46 mg/L	205 mg/L	5.94 mg/L	4.38 mg/L
TCKW0004	73.40 mg/L	6.18 mg/L	1.99 mg/L	1.28 mg/L	212 mg/L	5.00 mg/L	4.77 mg/L
TCKW0005	75.60 mg/L	7.16 mg/L	2.11 mg/L	1.15 mg/L	236 mg/L	5.00 mg/L	4.80 mg/L
TCKW0006	85.00 mg/L	8.17 mg/L	2.24 mg/L	1.31 mg/L	260 mg/L	5.00 mg/L	4.42 mg/L
TCKW0007	81.40 mg/L	8.23 mg/L	2.28 mg/L	1.10 mg/L	269 mg/L	5.25 mg/L	4.05 mg/L
Average*	76.04 mg/L	7.11 mg/L	2.11 mg/L	1.25 mg/L	236.86 mg/L	5.04 mg/L	4.50 mg/L
Maximum	85.00 mg/L	8.23 mg/L	2.28 mg/L	1.46 mg/L	269.00 mg/L	9.06 mg/L	4.82 mg/L
Minimum	67.50 mg/L	6.06 mg/L	1.95 mg/L	1.10 mg/L	205.00 mg/L	0.00 mg/L	4.05 mg/L
Standard Deviation	6.12	.90	.13	.13	25.84	2.66	.30
Coefficient Variation	.08	.13	.06	.10	.11	.53	.07
Number of analyses 7							

Shackelford Spring, August 1990–September 1991

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
SKSP0001	74.30 mg/L	5.59 mg/L	3.17 mg/L	1.32 mg/L	258 mg/L	6.59 mg/L	9.60 mg/L
SKSP0002	69.10 mg/L	5.45 mg/L	2.66 mg/L	1.30 mg/L	182 mg/L	5.69 mg/L	7.74 mg/L
SKSP0003	71.30 mg/L	5.54 mg/L	2.87 mg/L	1.10 mg/L	199 mg/L	10.60 mg/L	8.60 mg/L
SKSP0004	72.40 mg/L	5.65 mg/L	2.88 mg/L	0.93 mg/L	198 mg/L	7.11 mg/L	8.67 mg/L
SKSP0005	75.80 mg/L	5.81 mg/L	3.23 mg/L	1.05 mg/L	205 mg/L	6.04 mg/L	9.45 mg/L
SKSP0006	77.70 mg/L	5.99 mg/L	3.08 mg/L	1.07 mg/L	217 mg/L	12.60 mg/L	9.53 mg/L
SKSP0007	76.30 mg/L	6.00 mg/L	2.96 mg/L	1.18 mg/L	224 mg/L	8.76 mg/L	9.52 mg/L
Average*	73.84 mg/L	5.72 mg/L	2.98 mg/L	1.14 mg/L	211.86 mg/L	8.20 mg/L	9.02 mg/L
Maximum	77.70 mg/L	6.00 mg/L	3.23 mg/L	1.32 mg/L	258.00 mg/L	12.60 mg/L	9.60 mg/L
Minimum	69.10 mg/L	5.45 mg/L	2.66 mg/L	0.93 mg/L	182.00 mg/L	5.69 mg/L	7.74 mg/L
Standard Deviation	3.05	.22	.20	.14	24.49	2.59	.70
Coefficient Variation	.04	.04	.07	.12	.12	.32	.08
Number of analyses 7							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, August 1990–September 1991

Sample Number	*Total Calcium (mg/L as Ca)*	*Total Magnesium (mg/L as Mg)*	*Total Sodium (mg/L as Na)*	*Total Potassium (mg/L as K)*	*Bicarbonate (mg/L as HCO_3)*	*Total Sulfate (mg/L as SO_4)*	*Dissolved Chloride (mg/L as Cl)*
TFBH0001	62.10 mg/L	4.51 mg/L	2.91 mg/L	0.76 mg/L	157 mg/L	8.48 mg/L	10.40 mg/L
TFBH0002	67.20 mg/L	4.73 mg/L	3.19 mg/L	0.66 mg/L	188 mg/L	15.30 mg/L	10.80 mg/L
TFBH0003	64.60 mg/L	4.58 mg/L	3.17 mg/L	0.93 mg/L	183 mg/L	7.05 mg/L	10.30 mg/L
TFBH0004	68.80 mg/L	4.77 mg/L	3.10 mg/L	1.60 mg/L	184 mg/L	7.14 mg/L	9.52 mg/L
TFBH0005	72.10 mg/L	5.21 mg/L	3.08 mg/L	3.01 mg/L	248 mg/L	6.20 mg/L	10.40 mg/L
TFBH0006	1.00 mg/L	1.00 mg/L	1.00 mg/L	1.00 mg/L	45 mg/L	14.40 mg/L	2.00 mg/L
Average*	66.96 mg/L	4.76 mg/L	3.09 mg/L	1.39 mg/L	167.50 mg/L	9.76 mg/L	8.90 mg/L
Maximum	72.10 mg/L	5.21 mg/L	3.19 mg/L	3.01 mg/L	248.00 mg/L	15.30 mg/L	10.80 mg/L
Minimum	62.10 mg/L	4.51 mg/L	2.91 mg/L	0.66 mg/L	45.00 mg/L	6.20 mg/L	2.00 mg/L
Standard Deviation	3.84	.27	.11	.98	67.13	4.02	3.41
Coefficient Variation	.06	.06	.04	.70	.40	.41	.38
Number of analyses 6							

George Delaney swallow hole, August 1990–September 1991

Sample Number	*Total Calcium (mg/L as Ca)*	*Total Magnesium (mg/L as Mg)*	*Total Sodium (mg/L as Na)*	*Total Potassium (mg/L as K)*	*Bicarbonate (mg/L as HCO_3)*	*Total Sulfate (mg/L as SO_4)*	*Dissolved Chloride (mg/L as Cl)*
GDSW0001	68.20 mg/L	5.36 mg/L	3.04 mg/L	0.93 mg/L	188 mg/L	6.48 mg/L	8.45 mg/L
GDSW0002	71.60 mg/L	5.82 mg/L	2.75 mg/L	1.26 mg/L	191 mg/L	6.31 mg/L	7.81 mg/L
GDSW0003	71.50 mg/L	6.45 mg/L	2.75 mg/L	1.81 mg/L	216 mg/L	6.01 mg/L	8.04 mg/L
Average*	70.43 mg/L	5.88 mg/L	2.85 mg/L	1.33 mg/L	198.33 mg/L	6.27 mg/L	8.10 mg/L
Maximum	71.60 mg/L	6.45 mg/L	3.04 mg/L	1.81 mg/L	216.00 mg/L	6.48 mg/L	8.45 mg/L
Minimum	68.20 mg/L	5.36 mg/L	2.75 mg/L	0.93 mg/L	188.00 mg/L	6.01 mg/L	7.81 mg/L
Number of analyses 3							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0009	Oct/22/1991	08:50	3.69 mg/L	16.33 mg/L			0.037 mg/L
PGSP0010	Dec/17/1991	08:06	5.25 mg/L	23.23 mg/L			0.049 mg/L
PGSP0011	Jan/29/1992	11:00	4.77 mg/L	21.10 mg/L			0.030 mg/L
PGSP0012	Feb/26/1992	12:15	4.54 mg/L	20.10 mg/L			0.034 mg/L
PGSP0013	Mar/25/1992	13:20	5.00 mg/L	22.10 mg/L			0.027 mg/L
PGSP0014	Apr/01/1992	16:16	5.00 mg/L	22.10 mg/L			
PGSP0015	Apr/09/1992	15:28	4.75 mg/L	21.00 mg/L			
PGSP0016	Apr/16/1992	10:30	4.66 mg/L	20.60 mg/L			
PGSP0017	Apr/20/1992	18:55	4.66 mg/L	20.60 mg/L			
PGSP0018	Apr/21/1992	08:30	4.50 mg/L	19.90 mg/L			
PGSP0019	Apr/21/1992	17:55	4.54 mg/L	20.10 mg/L			
PGSP0020	Apr/22/1992	07:37	4.59 mg/L	20.30 mg/L			
PGSP0021	Apr/29/1992	09:40	4.38 mg/L	19.40 mg/L			0.034 mg/L
PGSP0022	May/07/1992	12:30	4.32 mg/L	19.11 mg/L			
PGSP0023	May/14/1992	08:30	4.30 mg/L	19.03 mg/L			
PGSP0024	May/20/1992	07:35	5.79 mg/L	25.60 mg/L			
PGSP0025	May/20/1992	14:30	1.00 mg/L	4.42 mg/L			
PGSP0026	May/27/1992	10:45	5.18 mg/L	22.90 mg/L			0.035 mg/L
PGSP0027	Jun/03/1992	15:45	5.83 mg/L	25.80 mg/L			0.049 mg/L
PGSP0028	Jun/04/1992	02:58	4.76 mg/L	21.06 mg/L			
PGSP0029	Jun/04/1992	03:18	4.71 mg/L	20.84 mg/L			
PGSP0030	Jun/04/1992	03:38	4.75 mg/L	21.02 mg/L			
PGSP0031	Jun/04/1992	03:58	4.77 mg/L	21.11 mg/L			
PGSP0032	Jun/04/1992	04:18	4.64 mg/L	20.53 mg/L			
PGSP0033	Jun/04/1992	04:38	4.24 mg/L	18.76 mg/L			
PGSP0034	Jun/04/1992	04:58	3.38 mg/L	14.96 mg/L			
PGSP0035	Jun/04/1992	05:18	3.72 mg/L	16.46 mg/L			
PGSP0036	Jun/04/1992	05:38	3.87 mg/L	17.12 mg/L			
PGSP0037	Jun/04/1992	05:58	3.96 mg/L	17.52 mg/L			
PGSP0038	Jun/04/1992	06:58	3.38 mg/L	14.96 mg/L			
PGSP0039	Jun/04/1992	07:58	3.80 mg/L	16.81 mg/L			
PGSP0040	Jun/04/1992	08:58	4.22 mg/L	18.67 mg/L			
PGSP0041	Jun/04/1992	09:58	4.42 mg/L	19.56 mg/L			
PGSP0042	Jun/04/1992	10:58	4.44 mg/L	19.65 mg/L			
PGSP0043	Jun/04/1992	11:58	4.67 mg/L	20.66 mg/L			
PGSP0044	Jun/04/1992	12:58	5.02 mg/L	22.21 mg/L			
PGSP0045	Jun/04/1992	13:58	5.10 mg/L	22.57 mg/L			
PGSP0046	Jun/04/1992	14:58	5.11 mg/L	22.61 mg/L			
PGSP0047	Jun/04/1992	15:58	4.80 mg/L	21.24 mg/L			
PGSP0052	Jun/04/1992	17:15	1.00 mg/L	4.42 mg/L			

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992
(Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0048	Jun/04/1992	19:55	5.09 mg/L	22.52 mg/L			
PGSP0049	Jun/04/1992	23:55	5.25 mg/L	23.23 mg/L			
PGSP0050	Jun/05/1992	03:55	5.37 mg/L	23.76 mg/L			
PGSP0051	Jun/05/1992	07:55	5.52 mg/L	24.42 mg/L			
PGSP0053	Jun/10/1992	13:20	5.03 mg/L	22.26 mg/L			
PGSP0054	Jun/18/1992	09:30	4.59 mg/L	20.30 mg/L			0.050 mg/L
PGSP0055	Jun/24/1992	13:35	4.84 mg/L	21.40 mg/L			
PGSP0056	Jul/01/1992	15:00	4.84 mg/L	21.40 mg/L			
PGSP0057	Jul/08/1992	11:15	4.66 mg/L	20.60 mg/L			
PGSP0058	Jul/13/1992	15:00	4.66 mg/L	20.60 mg/L			
PGSP0059	Jul/23/1992	15:45	4.70 mg/L	20.80 mg/L			
PGSP0060	Jul/30/1992	06:55	6.62 mg/L	29.30 mg/L			
PGSP0061	Aug/13/1992	14:15	4.61 mg/L	20.40 mg/L			
PGSP0062	Aug/26/1992	11:30	6.22 mg/L	27.50 mg/L			0.039 mg/L
PGSP0063	Sep/09/1992	11:42	4.48 mg/L	19.80 mg/L			
PGSP0064	Sep/23/1992	14:25	4.00 mg/L	17.70 mg/L			
		Average*	4.70 mg/L	20.81 mg/L			0.038 mg/L
		Maximum	6.62 mg/L	29.30 mg/L			0.050 mg/L
		Minimum	3.38 mg/L	14.96 mg/L			0.050 mg/L
		Standard Deviation	.62	2.75			.008
		Coefficient Variation	.13	.13			.215
Total of 56 analyses for Pleasant Grove Spring							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Spring Valley karst window, October 1991–September 1992

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
SVKW0008	Oct/22/1991	08:00	3.44 mg/L	15.22 mg/L			0.043 mg/L
SVKW0009	Jan/29/1992	10:00	4.79 mg/L	21.20 mg/L			0.027 mg/L
SVKW0010	Feb/26/1992	11:00	4.72 mg/L	20.90 mg/L			0.030 mg/L
SVKW0011	Mar/25/1992	10:55	5.13 mg/L	22.70 mg/L			0.027 mg/L
SVKW0012	Apr/01/1992	15:15	5.02 mg/L	22.20 mg/L			
SVKW0013	Apr/29/1992	08:40	4.52 mg/L	20.00 mg/L			0.039 mg/L
SVKW0014	May/27/1992	09:15	5.40 mg/L	23.90 mg/L			0.033 mg/L
		Average*	4.72 mg/L	20.87 mg/L			0.033 mg/L
		Maximum	5.40 mg/L	23.90 mg/L			0.043 mg/L
		Minimum	3.44 mg/L	15.22 mg/L			0.043 mg/L
		Standard Deviation	.63	2.80			.007
		Coefficient Variation	.13	.13			.199
Total of 7 analyses for Spring Valley karst window							

The Canyon karst window, October 1991–September 1992

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
TCKW0008	Dec/17/1991	11:30	4.00 mg/L	17.70 mg/L			0.040 mg/L
TCKW0009	Jan/29/1992	08:30	4.09 mg/L	18.10 mg/L			0.031 mg/L
TCKW0010	Feb/26/1992	09:45	3.80 mg/L	16.80 mg/L			0.026 mg/L
TCKW0011	Mar/25/1992	12:00	3.98 mg/L	17.60 mg/L			0.032 mg/L
TCKW0012	Apr/01/1992	14:45	3.89 mg/L	17.20 mg/L			
TCKW0013	Apr/29/1992	07:40	3.98 mg/L	17.60 mg/L			0.032 mg/L
TCKW0014	May/27/1992	10:05	5.02 mg/L	22.20 mg/L			0.030 mg/L
		Average*	4.11 mg/L	18.17 mg/L			0.032 mg/L
		Maximum	5.02 mg/L	22.20 mg/L			0.040 mg/L
		Minimum	3.80 mg/L	16.80 mg/L			0.040 mg/L
		Standard Deviation	.41	1.82			.005
		Coefficient Variation	.10	.10			.144
Total of 7 analyses for The Canyon karst window							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Shackelford Spring, October 1991–September 1992

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
SKSP0008	Oct/22/1991	06:34	6.52 mg/L	28.85 mg/L			0.035 mg/L
SKSP0009	Dec/17/1991	12:00	7.44 mg/L	32.92 mg/L			0.042 mg/L
SKSP0010	Jan/29/1992	14:30	7.41 mg/L	32.80 mg/L			0.028 mg/L
SKSP0011	Feb/26/1992	08:40	7.57 mg/L	33.50 mg/L			0.028 mg/L
SKSP0012	Mar/25/1992	08:40	7.10 mg/L	31.40 mg/L			0.028 mg/L
SKSP0013	Apr/29/1992	06:43	7.19 mg/L	31.80 mg/L			0.027 mg/L
SKSP0014	May/27/1992	11:50	8.50 mg/L	37.60 mg/L			0.033 mg/L
		Average*	7.39 mg/L	32.70 mg/L			0.032 mg/L
		Maximum	8.50 mg/L	37.60 mg/L			0.042 mg/L
		Minimum	6.52 mg/L	28.85 mg/L			0.042 mg/L
		Standard Deviation	.60	2.65			.006
		Coefficient Variation	.08	.08			.174
Total of 7 analyses for Shackelford Spring							

Thad Flowers bluehole, October 1991–September 1992

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
TFBH0007	Dec/17/1991	13:30	8.46 mg/L	37.43 mg/L			0.035 mg/L
TFBH0008	Jan/29/1992	07:50	7.23 mg/L	32.00 mg/L			0.026 mg/L
TFBH0009	Feb/26/1992	07:30	3.10 mg/L	13.70 mg/L			0.016 mg/L
TFBH0010	Mar/25/1992	07:20	7.03 mg/L	31.10 mg/L			0.018 mg/L
		Average*	6.45 mg/L	28.56 mg/L			0.024 mg/L
		Maximum	8.46 mg/L	37.43 mg/L			0.035 mg/L
		Minimum	3.10 mg/L	13.70 mg/L			0.035 mg/L
		Standard Deviation	2.33	10.29			.009
		Coefficient Variation	.36	.36			.364
Total of 4 analyses for Thad Flowers bluehole							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

George Delaney swallow hole, October 1991–September 1992

Sample Number	*Date*	*Time (CST)*	*Total Nitrate-Nitrogen (mg/L as N)*	*Total Nitrate-Nitrogen (mg/L as NO_3)*	*Ammonia, Unionized (mg/L as NH_3)*	*Total Kjeldahl Nitrogen (mg/L as N)*	*Orthophosphate (mg/L as PO_4)*
GDSW0004	Dec/17/1991	10:00	7.15 mg/L	31.64 mg/L			0.051 mg/L
GDSW0005	Jan/29/1992	09:10	6.69 mg/L	29.60 mg/L			0.018 mg/L
GDSW0006	Feb/26/1992	10:20	6.80 mg/L	30.10 mg/L			0.072 mg/L
GDSW0007	Mar/25/1992	09:45	6.94 mg/L	30.70 mg/L			0.018 mg/L
GDSW0008	Apr/01/1992	15:45	6.80 mg/L	30.10 mg/L			
		Average*	6.88 mg/L	30.43 mg/L			0.040 mg/L
		Maximum	7.15 mg/L	31.64 mg/L			0.072 mg/L
		Minimum	6.69 mg/L	29.60 mg/L			0.072 mg/L
		Standard Deviation	.18	.78			.027
		Coefficient Variation	.03	.03			.668
Total of 5 analyses for George Delaney swallow hole							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
PGSP0009	6.90 SU	490 µS	238.00 mg/L	274 mg/L	3 mg/L	0.061 mg/L
PGSP0010	7.00 SU	384 µS	165.00 mg/L	218 mg/L	37 mg/L	1.350 mg/L
PGSP0011	7.30 SU	427 µS	190.00 mg/L	218 mg/L	4 mg/L	0.071 mg/L
PGSP0012	7.12 SU	429 µS	196.00 mg/L	280 mg/L	6 mg/L	0.406 mg/L
PGSP0013	6.63 SU	393 µS	175.00 mg/L	254 mg/L	9 mg/L	0.178 mg/L
PGSP0021	6.30 SU	425 µS	196.00 mg/L	246 mg/L	3 mg/L	0.075 mg/L
PGSP0026	7.22 SU	434 µS	201.00 mg/L	286 mg/L	3 mg/L	0.224 mg/L
PGSP0027	7.09 SU	418 µS	189.00 mg/L	270 mg/L	4 mg/L	0.358 mg/L
PGSP0028				268 mg/L	8 mg/L	
PGSP0029				304 mg/L	35 mg/L	
PGSP0030				322 mg/L	34 mg/L	
PGSP0031				290 mg/L	114 mg/L	
PGSP0032				300 mg/L	186 mg/L	
PGSP0033				242 mg/L	370 mg/L	
PGSP0034				190 mg/L	667 mg/L	
PGSP0035				242 mg/L	311 mg/L	
PGSP0036				254 mg/L	249 mg/L	
PGSP0037				268 mg/L	289 mg/L	
PGSP0038				248 mg/L	597 mg/L	
PGSP0039				326 mg/L	294 mg/L	
PGSP0040				328 mg/L	302 mg/L	
PGSP0041				322 mg/L	196 mg/L	
PGSP0042				294 mg/L	122 mg/L	
PGSP0043				260 mg/L	116 mg/L	
PGSP0044				272 mg/L	101 mg/L	
PGSP0045				260 mg/L	128 mg/L	
PGSP0046				262 mg/L	113 mg/L	
PGSP0047				234 mg/L	115 mg/L	
PGSP0048				224 mg/L	99 mg/L	
PGSP0049				208 mg/L	62 mg/L	
PGSP0050				216 mg/L	45 mg/L	
PGSP0051				232 mg/L	35 mg/L	
PGSP0054	6.74 SU	414 µS	186.00 mg/L	262 mg/L	3 mg/L	0.257 mg/L
PGSP0057				274 mg/L	11 mg/L	
PGSP0058				250 mg/L	4 mg/L	
PGSP0062	7.01 SU	476 µS	225.00 mg/L	280 mg/L	3 mg/L	0.018 mg/L

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992 (Continued)

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
Average*	6.93 SU	429 µS	196.10 mg/L	263 mg/L	129.94 mg/L	0.300 mg/L
Maximum	7.30 SU	490 µS	238.00 mg/L	328 mg/L	667.00 mg/L	1.350 mg/L
Minimum	6.30 SU	384 µS	165.00 mg/L	190 mg/L	3.00 mg/L	0.018 mg/L
Standard Deviation	.30	32.7	21.65	34.3	163.72	.391
Coefficient Variation	.04	.1	.11	.1	1.26	1.306
Total of 36 analyses for Pleasant Grove Spring						

Spring Valley karst window, October 1991–September 1992

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
SVKW0008	6.75 SU	492 µS	237.00 mg/L	272 mg/L	3 mg/L	0.067 mg/L
SVKW0009	7.29 SU	427 µS	190.00 mg/L	230 mg/L	5 mg/L	0.119 mg/L
SVKW0010	7.13 SU	430 µS	195.00 mg/L	286 mg/L	6 mg/L	0.283 mg/L
SVKW0011	6.55 SU	395 µS	175.00 mg/L	256 mg/L	12 mg/L	0.241 mg/L
SVKW0013	6.15 SU	431 µS	197.00 mg/L	242 mg/L	6 mg/L	0.093 mg/L
SVKW0014	7.19 SU	433 µS	202.00 mg/L	280 mg/L	3 mg/L	0.207 mg/L
Average*	6.84 SU	435 µS	199.33 mg/L	261 mg/L	5.83 mg/L	0.168 mg/L
Maximum	7.29 SU	492 µS	237.00 mg/L	286 mg/L	12.00 mg/L	0.283 mg/L
Minimum	6.15 SU	395 µS	175.00 mg/L	230 mg/L	3.00 mg/L	0.067 mg/L
Standard Deviation	.44	31.5	20.64	22.2	3.31	.088
Coefficient Variation	.06	.1	.10	.1	.57	.520
Total of 6 analyses for Spring Valley karst window						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, October 1991–September 1992

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
TCKW0008	6.87 SU	389 µS	177.00 mg/L	226 mg/L	20 mg/L	0.993 mg/L
TCKW0009	7.12 SU	425 µS	194.00 mg/L	236 mg/L	22 mg/L	0.680 mg/L
TCKW0010	6.98 SU	431 µS	205.00 mg/L	260 mg/L	16 mg/L	0.489 mg/L
TCKW0011	6.56 SU	392 µS	184.00 mg/L	252 mg/L	36 mg/L	0.964 mg/L
TCKW0013	5.99 SU	424 µS	200.00 mg/L	256 mg/L	17 mg/L	0.445 mg/L
TCKW0014	7.07 SU	427 µS	202.00 mg/L	268 mg/L	8 mg/L	0.630 mg/L
Average*	6.77 SU	415 µS	193.67 mg/L	250 mg/L	19.83 mg/L	0.700 mg/L
Maximum	7.12 SU	431 µS	205.00 mg/L	268 mg/L	36.00 mg/L	0.993 mg/L
Minimum	5.99 SU	389 µS	177.00 mg/L	226 mg/L	8.00 mg/L	0.445 mg/L
Standard Deviation	.43	18.9	11.04	15.7	9.26	.233
Coefficient Variation	.06		.06	.1	.47	.332
Total of 6 analyses for The Canyon karst window						

Shackelford Spring, October 1991–September 1992

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
SKSP0008	6.75 SU	450 µS	190.00 mg/L	256 mg/L	4 mg/L	0.272 mg/L
SKSP0009	7.06 SU	423 µS	170.00 mg/L	244 mg/L	14 mg/L	0.365 mg/L
SKSP0010	7.27 SU	429 µS	171.00 mg/L	238 mg/L	5 mg/L	0.184 mg/L
SKSP0011	7.11 SU	428 µS	171.00 mg/L	316 mg/L	6 mg/L	0.184 mg/L
SKSP0012	6.57 SU	413 µS	170.00 mg/L	298 mg/L	4 mg/L	0.126 mg/L
SKSP0013	6.09 SU	418 µS	169.00 mg/L	268 mg/L	4 mg/L	0.204 mg/L
SKSP0014	7.29 SU	427 µS	173.00 mg/L	288 mg/L	6 mg/L	0.167 mg/L
Average*	6.88 SU	427 µS	173.43 mg/L	273 mg/L	6.14 mg/L	0.215 mg/L
Maximum	7.29 SU	450 µS	190.00 mg/L	316 mg/L	14.00 mg/L	0.365 mg/L
Minimum	6.09 SU	413 µS	169.00 mg/L	238 mg/L	4.00 mg/L	0.126 mg/L
Standard Deviation	.44	11.7	7.41	29.1	3.58	.080
Coefficient Variation	.06		.04	.1	.58	.371
Total of 7 analyses for Shackelford Spring						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, October 1991–September 1992

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
TFBH0007	7.09 SU	365 µS	133.00 mg/L	202 mg/L	18 mg/L	0.367 mg/L
TFBH0008	7.71 SU	402 µS	152.00 mg/L	218 mg/L	20 mg/L	0.494 mg/L
TFBH0009	7.63 SU	365 µS	152.00 mg/L	226 mg/L	34 mg/L	0.616 mg/L
TFBH0010	6.50 SU	362 µS	137.00 mg/L	250 mg/L	4 mg/L	0.047 mg/L
Average*	7.23 SU	374 µS	143.50 mg/L	224 mg/L	19.00 mg/L	0.381 mg/L
Maximum	7.71 SU	402 µS	152.00 mg/L	250 mg/L	34.00 mg/L	0.616 mg/L
Minimum	6.50 SU	362 µS	133.00 mg/L	202 mg/L	4.00 mg/L	0.047 mg/L
Standard Deviation	.56	19.1	9.95	20.0	12.27	.245
Coefficient Variation	.08	.1	.07	.1	.65	.642
Total of 4 analyses for Thad Flowers bluehole						

George Delaney swallow hole, October 1991–September 1992

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
GDSW0004	7.46 SU	386 µS	149.00 mg/L	216 mg/L	12 mg/L	0.395 mg/L
GDSW0005	7.68 SU	418 µS	168.00 mg/L	218 mg/L	8 mg/L	0.168 mg/L
GDSW0006	7.62 SU	408 µS	164.00 mg/L	305 mg/L	22 mg/L	0.420 mg/L
GDSW0007	7.00 SU	389 µS	156.00 mg/L	274 mg/L	14 mg/L	0.230 mg/L
Average*	7.44 SU	400 µS	159.25 mg/L	253 mg/L	14.00 mg/L	0.303 mg/L
Maximum	7.68 SU	418 µS	168.00 mg/L	305 mg/L	22.00 mg/L	0.420 mg/L
Minimum	7.00 SU	386 µS	149.00 mg/L	216 mg/L	8.00 mg/L	0.168 mg/L
Standard Deviation	.31	15.3	8.46	43.7	5.89	.123
Coefficient Variation	.04		.05	.2	.42	.407
Total of 4 analyses for George Delaney swallow hole						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
PGSP0009	88.90 mg/L	8.85 mg/L	2.24 mg/L	0.93 mg/L	290 mg/L	6.24 mg/L	4.13 mg/L
PGSP0010	76.90 mg/L	6.58 mg/L	2.46 mg/L	1.77 mg/L	201 mg/L	5.60 mg/L	5.83 mg/L
PGSP0011	76.30 mg/L	6.96 mg/L	2.33 mg/L	0.92 mg/L	232 mg/L	5.53 mg/L	10.30 mg/L
PGSP0012	79.00 mg/L	7.21 mg/L	2.48 mg/L	1.62 mg/L	239 mg/L	6.02 mg/L	6.22 mg/L
PGSP0013	70.70 mg/L	6.17 mg/L	2.40 mg/L	1.20 mg/L	213 mg/L	5.26 mg/L	6.41 mg/L
PGSP0021	78.90 mg/L	7.38 mg/L	2.37 mg/L	1.42 mg/L	239 mg/L	5.18 mg/L	4.87 mg/L
PGSP0026	79.90 mg/L	7.66 mg/L	2.32 mg/L	1.31 mg/L	245 mg/L	5.66 mg/L	5.26 mg/L
PGSP0027	75.70 mg/L	6.99 mg/L	2.21 mg/L	1.23 mg/L	230 mg/L	5.14 mg/L	5.29 mg/L
PGSP0054	69.90 mg/L	6.55 mg/L	2.18 mg/L	0.72 mg/L	227 mg/L	5.26 mg/L	4.56 mg/L
PGSP0062	83.40 mg/L	8.23 mg/L	3.10 mg/L	0.72 mg/L	274 mg/L	5.54 mg/L	5.91 mg/L
Average*	77.96 mg/L	7.26 mg/L	2.41 mg/L	1.18 mg/L	239.00 mg/L	5.54 mg/L	5.88 mg/L
Maximum	88.90 mg/L	8.85 mg/L	3.10 mg/L	1.77 mg/L	290.00 mg/L	6.24 mg/L	10.30 mg/L
Minimum	69.90 mg/L	6.17 mg/L	2.18 mg/L	0.72 mg/L	201.00 mg/L	5.14 mg/L	4.13 mg/L
Standard Deviation	5.59	.81	.26	.36	26.36	.36	1.72
Coefficient Variation	.07	.11	.11	.30	.11	.07	.29
Total of 10 analyses for Pleasant Grove Spring							

Spring Valley karst window, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
SVKW0008	89.30 mg/L	9.11 mg/L	2.26 mg/L	0.94 mg/L	289 mg/L	6.54 mg/L	4.92 mg/L
SVKW0009	75.10 mg/L	6.97 mg/L	2.31 mg/L	1.14 mg/L	232 mg/L	5.18 mg/L	6.22 mg/L
SVKW0010	78.40 mg/L	7.21 mg/L	2.48 mg/L	1.33 mg/L	238 mg/L	6.27 mg/L	6.53 mg/L
SVKW0011	70.60 mg/L	6.22 mg/L	2.44 mg/L	0.96 mg/L	213 mg/L	5.34 mg/L	6.66 mg/L
SVKW0013	78.10 mg/L	7.41 mg/L	2.31 mg/L	1.11 mg/L	240 mg/L	5.24 mg/L	5.04 mg/L
SVKW0014	80.30 mg/L	7.83 mg/L	2.35 mg/L	1.24 mg/L	246 mg/L	5.68 mg/L	5.38 mg/L
Average*	78.63 mg/L	7.46 mg/L	2.36 mg/L	1.12 mg/L	243.00 mg/L	5.71 mg/L	5.79 mg/L
Maximum	89.30 mg/L	9.11 mg/L	2.48 mg/L	1.33 mg/L	289.00 mg/L	6.54 mg/L	6.66 mg/L
Minimum	70.60 mg/L	6.22 mg/L	2.26 mg/L	0.94 mg/L	213.00 mg/L	5.18 mg/L	4.92 mg/L
Standard Deviation	6.23	.97	.08	.15	25.22	.57	.77
Coefficient Variation	.08	.13	.04	.14	.10	.10	.13
Total of 6 analyses for Spring Valley karst window							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
TCKW0008	73.60 mg/L	6.17 mg/L	1.94 mg/L	1.37 mg/L	216 mg/L	5.26 mg/L	4.34 mg/L
TCKW0009	77.00 mg/L	6.81 mg/L	2.15 mg/L	1.15 mg/L	236 mg/L	5.00 mg/L	5.11 mg/L
TCKW0010	79.70 mg/L	6.92 mg/L	2.18 mg/L	1.51 mg/L	250 mg/L	5.07 mg/L	4.11 mg/L
TCKW0011	71.40 mg/L	6.18 mg/L	2.02 mg/L	1.42 mg/L	224 mg/L	5.00 mg/L	4.82 mg/L
TCKW0013	80.10 mg/L	7.26 mg/L	2.29 mg/L	1.17 mg/L	244 mg/L	5.00 mg/L	4.25 mg/L
TCKW0014	78.20 mg/L	7.14 mg/L	2.16 mg/L	1.48 mg/L	246 mg/L	5.00 mg/L	4.36 mg/L
Average*	76.67 mg/L	6.75 mg/L	2.12 mg/L	1.35 mg/L	236.00 mg/L	5.06 mg/L	4.50 mg/L
Maximum	80.10 mg/L	7.26 mg/L	2.29 mg/L	1.51 mg/L	250.00 mg/L	5.26 mg/L	5.11 mg/L
Minimum	71.40 mg/L	6.17 mg/L	1.94 mg/L	1.15 mg/L	216.00 mg/L	5.00 mg/L	4.11 mg/L
Standard Deviation	3.48	.47	.12	.16	13.45	.10	.38
Coefficient Variation	.05	.07	.06	.11	.06	.02	.09
Total of 6 analyses for The Canyon karst window							

Shackelford Spring, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
SKSP0008	78.00 mg/L	6.02 mg/L	3.04 mg/L	0.93 mg/L	232 mg/L	7.40 mg/L	9.29 mg/L
SKSP0009	75.90 mg/L	5.90 mg/L	2.85 mg/L	1.39 mg/L	207 mg/L	6.80 mg/L	8.05 mg/L
SKSP0010	76.60 mg/L	5.85 mg/L	3.02 mg/L	1.18 mg/L	208 mg/L	6.44 mg/L	9.72 mg/L
SKSP0011	77.00 mg/L	5.90 mg/L	3.14 mg/L	1.35 mg/L	208 mg/L	7.47 mg/L	9.96 mg/L
SKSP0012	75.80 mg/L	5.85 mg/L	2.95 mg/L	1.20 mg/L	207 mg/L	6.47 mg/L	8.81 mg/L
SKSP0013	76.10 mg/L	5.81 mg/L	3.03 mg/L	1.15 mg/L	206 mg/L	6.33 mg/L	8.80 mg/L
SKSP0014	75.20 mg/L	5.84 mg/L	3.20 mg/L	1.04 mg/L	211 mg/L	7.32 mg/L	10.00 mg/L
Average*	76.37 mg/L	5.88 mg/L	3.03 mg/L	1.18 mg/L	211.29 mg/L	6.89 mg/L	9.23 mg/L
Maximum	78.00 mg/L	6.02 mg/L	3.20 mg/L	1.39 mg/L	232.00 mg/L	7.47 mg/L	10.00 mg/L
Minimum	75.20 mg/L	5.81 mg/L	2.85 mg/L	0.93 mg/L	206.00 mg/L	6.33 mg/L	8.05 mg/L
Standard Deviation	.92	.07	.12	.16	9.27	.50	.72
Coefficient Variation	.01	.01	.04	.14	.04	.07	.08
Total of 7 analyses for Shackelford Spring							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
TFBH0007	65.60 mg/L	4.63 mg/L	2.84 mg/L	0.93 mg/L	162 mg/L	5.51 mg/L	11.00 mg/L
TFBH0008	71.50 mg/L	5.03 mg/L	3.20 mg/L	0.95 mg/L	185 mg/L	6.83 mg/L	12.80 mg/L
TFBH0009	67.00 mg/L	5.25 mg/L	3.20 mg/L	1.35 mg/L	185 mg/L	8.98 mg/L	12.80 mg/L
TFBH0010	63.30 mg/L	4.60 mg/L	3.01 mg/L	0.72 mg/L	167 mg/L	7.87 mg/L	11.00 mg/L
Average*	66.85 mg/L	4.88 mg/L	3.06 mg/L	0.99 mg/L	174.75 mg/L	7.30 mg/L	11.90 mg/L
Maximum	71.50 mg/L	5.25 mg/L	3.20 mg/L	1.35 mg/L	185.00 mg/L	8.98 mg/L	12.80 mg/L
Minimum	63.30 mg/L	4.60 mg/L	2.84 mg/L	0.72 mg/L	162.00 mg/L	5.51 mg/L	11.00 mg/L
Standard Deviation	3.45	.32	.17	.26	12.01	1.48	1.04
Coefficient Variation	.05	.06	.06	.27	.07	.20	.09
Total of 4 analyses for Thad Flowers bluehole							

George Delaney swallow hole, October 1991–September 1992

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
GDSW0004	66.50 mg/L	5.21 mg/L	2.94 mg/L	1.68 mg/L	182 mg/L	7.51 mg/L	9.76 mg/L
GDSW0005	71.50 mg/L	6.04 mg/L	3.18 mg/L	1.06 mg/L	205 mg/L	6.72 mg/L	10.10 mg/L
GDSW0006	71.60 mg/L	5.67 mg/L	3.63 mg/L	2.19 mg/L	200 mg/L	8.61 mg/L	10.20 mg/L
GDSW0007	68.90 mg/L	5.38 mg/L	3.18 mg/L	0.88 mg/L	190 mg/L	6.82 mg/L	9.82 mg/L
Average*	69.63 mg/L	5.58 mg/L	3.23 mg/L	1.45 mg/L	194.25 mg/L	7.42 mg/L	9.97 mg/L
Maximum	71.60 mg/L	6.04 mg/L	3.63 mg/L	2.19 mg/L	205.00 mg/L	8.61 mg/L	10.20 mg/L
Minimum	66.50 mg/L	5.21 mg/L	2.94 mg/L	0.88 mg/L	182.00 mg/L	6.72 mg/L	9.76 mg/L
Standard Deviation	2.43	.36	.29	.60	10.28	.87	.21
Coefficient Variation	.03	.07	.09	.41	.05	.12	.02
Total of 4 analyses for George Delaney swallow hole							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1992–September 1993

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0065	Oct/06/1992	12:50	4.29 mg/L	19.00 mg/L			0.033 mg/L
PGSP0066	Oct/22/1992	10:14	4.00 mg/L	17.70 mg/L			
PGSP0067	Nov/06/1992	09:00	3.84 mg/L	17.00 mg/L			0.044 mg/L
PGSP0068	Nov/20/1992	11:54	3.96 mg/L	17.50 mg/L			
PGSP0070	Dec/03/1992	09:07	4.02 mg/L	17.80 mg/L			0.083 mg/L
PGSP0071	Jan/08/1993	10:19	5.18 mg/L	22.90 mg/L			0.045 mg/L
PGSP0072	Jan/13/1993	08:00	5.29 mg/L	23.40 mg/L			
PGSP0073	Jan/13/1993	09:00	5.56 mg/L	24.60 mg/L			
PGSP0074	Jan/13/1993	10:00	5.51 mg/L	24.40 mg/L			
PGSP0075	Jan/13/1993	11:00	5.49 mg/L	24.30 mg/L			
PGSP0076	Jan/13/1993	12:00	5.44 mg/L	24.07 mg/L			
PGSP0077	Jan/13/1993	13:00	5.38 mg/L	23.80 mg/L			
PGSP0078	Jan/13/1993	14:00	5.47 mg/L	24.20 mg/L			
PGSP0079	Jan/13/1993	15:00	5.40 mg/L	23.89 mg/L			
PGSP0080	Jan/13/1993	16:00	5.42 mg/L	24.00 mg/L			
PGSP0081	Jan/13/1993	17:00	5.40 mg/L	23.90 mg/L			
PGSP0082	Jan/21/1993	10:15	5.33 mg/L	23.60 mg/L			
PGSP0083	Jan/28/1993	15:06	5.54 mg/L	24.50 mg/L			
PGSP0084	Jan/28/1993	15:40	5.33 mg/L	23.60 mg/L			
PGSP0089	Jan/28/1993	20:40	5.40 mg/L	23.90 mg/L			
PGSP0095	Jan/29/1993	02:40	5.45 mg/L	24.10 mg/L			
PGSP0101	Jan/29/1993	08:40	5.40 mg/L	23.90 mg/L			
PGSP0107	Jan/29/1993	14:40	5.38 mg/L	23.80 mg/L			
PGSP0108	Feb/04/1993	10:00	5.24 mg/L	23.20 mg/L			0.045 mg/L
PGSP0109	Feb/16/1993	06:10	4.97 mg/L	22.00 mg/L			
PGSP0110	Feb/16/1993	06:30	5.02 mg/L	22.20 mg/L			
PGSP0111	Feb/16/1993	06:50	4.93 mg/L	21.80 mg/L			
PGSP0112	Feb/16/1993	07:10	4.95 mg/L	21.90 mg/L			
PGSP0113	Feb/16/1993	07:30	4.95 mg/L	21.90 mg/L			
PGSP0114	Feb/16/1993	07:50	4.93 mg/L	21.80 mg/L			
PGSP0115	Feb/16/1993	08:10	5.11 mg/L	22.60 mg/L			
PGSP0116	Feb/16/1993	08:30	5.04 mg/L	22.30 mg/L			
PGSP0117	Feb/16/1993	08:50	4.93 mg/L	21.80 mg/L			
PGSP0118	Feb/16/1993	09:10	5.02 mg/L	22.20 mg/L			
PGSP0119	Feb/16/1993	10:10	4.84 mg/L	21.40 mg/L			
PGSP0120	Feb/16/1993	11:10	4.97 mg/L	22.00 mg/L			
PGSP0121	Feb/16/1993	12:10	4.84 mg/L	21.40 mg/L			
PGSP0122	Feb/16/1993	13:10	5.02 mg/L	22.20 mg/L			
PGSP0123	Feb/16/1993	14:10	4.88 mg/L	21.60 mg/L			
PGSP0124	Feb/16/1993	15:10	4.97 mg/L	22.00 mg/L			

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Pleasant Grove Spring, October 1992–September 1993 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0125	Feb/16/1993	16:10	5.00 mg/L	22.10 mg/L			
PGSP0126	Feb/16/1993	17:10	5.00 mg/L	22.10 mg/L			
PGSP0127	Feb/16/1993	18:10	5.06 mg/L	22.40 mg/L			
PGSP0128	Feb/16/1993	19:10	5.00 mg/L	22.10 mg/L			
PGSP0129	Feb/16/1993	23:10	4.90 mg/L	21.70 mg/L			
PGSP0130	Feb/17/1993	03:10	4.68 mg/L	20.70 mg/L			
PGSP0131	Feb/17/1993	07:10	4.88 mg/L	21.60 mg/L			
PGSP0132	Feb/17/1993	11:10	5.06 mg/L	22.40 mg/L			
PGSP0133	Feb/17/1993	16:30	5.29 mg/L	23.40 mg/L			
PGSP0134	Feb/18/1993	08:00	5.42 mg/L	24.00 mg/L			
PGSP0135	Feb/21/1993	10:13	5.15 mg/L	22.80 mg/L			
PGSP0136	Feb/21/1993	10:33	5.02 mg/L	22.20 mg/L			
PGSP0137	Feb/21/1993	10:53	5.13 mg/L	22.70 mg/L			
PGSP0138	Feb/21/1993	11:13	5.11 mg/L	22.60 mg/L			
PGSP0139	Feb/21/1993	11:33	4.97 mg/L	22.00 mg/L			
PGSP0140	Feb/21/1993	11:53	4.95 mg/L	21.90 mg/L			
PGSP0141	Feb/21/1993	12:13	5.00 mg/L	22.10 mg/L			
PGSP0142	Feb/21/1993	12:33	5.02 mg/L	22.20 mg/L			
PGSP0143	Feb/21/1993	12:53	4.93 mg/L	21.80 mg/L			
PGSP0144	Feb/21/1993	13:13	4.88 mg/L	21.60 mg/L			
PGSP0145	Feb/21/1993	14:13	4.93 mg/L	21.80 mg/L			
PGSP0146	Feb/21/1993	15:13	5.02 mg/L	22.20 mg/L			
PGSP0147	Feb/21/1993	16:13	5.18 mg/L	22.90 mg/L			
PGSP0148	Feb/21/1993	17:13	5.11 mg/L	22.60 mg/L			
PGSP0149	Feb/21/1993	18:13	5.11 mg/L	22.60 mg/L			
PGSP0150	Feb/21/1993	19:13	5.20 mg/L	23.00 mg/L			
PGSP0151	Feb/21/1993	20:13	5.24 mg/L	23.20 mg/L			
PGSP0152	Feb/21/1993	21:13	5.24 mg/L	23.20 mg/L			
PGSP0153	Feb/21/1993	22:13	5.00 mg/L	22.10 mg/L			
PGSP0154	Feb/21/1993	23:13	5.20 mg/L	23.00 mg/L			
PGSP0155	Feb/22/1993	03:13	5.20 mg/L	23.00 mg/L			
PGSP0156	Feb/22/1993	07:13	5.20 mg/L	23.00 mg/L			
PGSP0157	Feb/22/1993	11:13	5.13 mg/L	22.70 mg/L			
PGSP0158	Feb/22/1993	15:13	5.29 mg/L	23.40 mg/L			
PGSP0159	Mar/03/1993	09:00	4.66 mg/L	20.60 mg/L			0.078 mg/L
PGSP0160	Mar/18/1993	10:20	5.45 mg/L	24.10 mg/L			
PGSP0161	Mar/22/1993	20:15	5.22 mg/L	23.10 mg/L			
PGSP0172	Mar/23/1993	01:15	5.15 mg/L	22.80 mg/L			
PGSP0176	Mar/23/1993	05:15	5.09 mg/L	22.50 mg/L			

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Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0180	Mar/23/1993	09:15	5.00 mg/L	22.10 mg/L			
PGSP0181	Mar/23/1993	13:15	4.45 mg/L	19.70 mg/L			
PGSP0182	Mar/23/1993	17:15	4.48 mg/L	19.80 mg/L			
PGSP0183	Mar/23/1993	21:15	4.86 mg/L	21.50 mg/L			
PGSP0184	Mar/24/1993	01:15	4.90 mg/L	21.70 mg/L			
PGSP0185	Mar/25/1993	11:00	5.33 mg/L	23.60 mg/L			
PGSP0186	Mar/26/1993	02:28	5.20 mg/L	23.00 mg/L			
PGSP0187	Mar/26/1993	02:48	5.09 mg/L	22.50 mg/L			
PGSP0188	Mar/26/1993	03:08	5.02 mg/L	22.20 mg/L			
PGSP0189	Mar/26/1993	03:28	5.13 mg/L	22.70 mg/L			
PGSP0190	Mar/26/1993	03:48	5.13 mg/L	22.70 mg/L			
PGSP0191	Mar/26/1993	04:08	5.13 mg/L	22.70 mg/L			
PGSP0192	Mar/26/1993	04:28	4.75 mg/L	21.00 mg/L			
PGSP0193	Mar/26/1993	04:48	5.06 mg/L	22.40 mg/L			
PGSP0194	Mar/26/1993	05:08	5.04 mg/L	22.30 mg/L			
PGSP0195	Mar/26/1993	05:28	5.04 mg/L	22.30 mg/L			
PGSP0196	Mar/26/1993	06:28	5.06 mg/L	22.40 mg/L			
PGSP0197	Mar/26/1993	07:28	5.24 mg/L	23.20 mg/L			
PGSP0198	Mar/26/1993	08:28	5.18 mg/L	22.90 mg/L			
PGSP0199	Mar/26/1993	09:28	5.24 mg/L	23.20 mg/L			
PGSP0200	Mar/26/1993	10:28	5.18 mg/L	22.90 mg/L			
PGSP0201	Mar/26/1993	11:28	4.77 mg/L	21.10 mg/L			
PGSP0202	Mar/26/1993	12:28	4.48 mg/L	19.80 mg/L			
PGSP0203	Mar/26/1993	13:28	4.38 mg/L	19.40 mg/L			
PGSP0204	Mar/26/1993	14:28	4.43 mg/L	19.60 mg/L			
PGSP0205	Mar/26/1993	15:28	4.50 mg/L	19.90 mg/L			
PGSP0206	Mar/26/1993	19:28	4.52 mg/L	20.00 mg/L			
PGSP0207	Mar/26/1993	23:28	4.84 mg/L	21.40 mg/L			
PGSP0208	Mar/27/1993	03:28	5.09 mg/L	22.50 mg/L			
PGSP0209	Mar/27/1993	07:28	5.09 mg/L	22.50 mg/L			
PGSP0210	Apr/01/1993	16:54	5.15 mg/L	22.80 mg/L			
PGSP0211	Apr/07/1993	08:22	5.09 mg/L	22.50 mg/L			0.033 mg/L
PGSP0212	Apr/21/1993	15:10	5.04 mg/L	22.30 mg/L			
PGSP0213	May/03/1993	17:39	4.70 mg/L	20.80 mg/L			
PGSP0214	May/03/1993	18:39	4.81 mg/L	21.30 mg/L			
PGSP0215	May/04/1993	13:55	4.25 mg/L	18.80 mg/L			0.310 mg/L
PGSP0216	May/04/1993	14:50	4.84 mg/L	21.40 mg/L			
PGSP0217	May/04/1993	15:50	5.06 mg/L	22.40 mg/L			
PGSP0218	May/04/1993	16:50	5.06 mg/L	22.40 mg/L			

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Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0219	May/04/1993	17:50	5.20 mg/L	23.00 mg/L			
PGSP0220	May/04/1993	18:50	5.29 mg/L	23.40 mg/L			
PGSP0221	May/04/1993	19:50	5.27 mg/L	23.30 mg/L			
PGSP0222	May/04/1993	20:50	5.31 mg/L	23.50 mg/L			
PGSP0223	May/04/1993	21:50	5.38 mg/L	23.80 mg/L			
PGSP0224	May/04/1993	22:50	5.38 mg/L	23.80 mg/L			
PGSP0225	May/05/1993	01:50	5.56 mg/L	24.60 mg/L			
PGSP0226	May/05/1993	04:50	5.79 mg/L	25.60 mg/L			
PGSP0227	May/05/1993	07:50	5.97 mg/L	26.40 mg/L			
PGSP0228	May/05/1993	10:50	6.08 mg/L	26.90 mg/L			
PGSP0229	May/05/1993	13:50	5.81 mg/L	25.70 mg/L			
PGSP0230	May/05/1993	16:50	5.94 mg/L	26.30 mg/L			
PGSP0231	May/05/1993	19:50	5.74 mg/L	25.40 mg/L			
PGSP0232	May/05/1993	22:50	5.74 mg/L	25.40 mg/L			
PGSP0233	May/06/1993	01:50	5.94 mg/L	26.30 mg/L			
PGSP0234	May/06/1993	09:15	5.62 mg/L	24.87 mg/L			
PGSP0235	May/18/1993	03:22	4.88 mg/L	21.60 mg/L			
PGSP0241	May/18/1993	09:22	4.95 mg/L	21.90 mg/L			
PGSP0251	May/19/1993	09:22	5.06 mg/L	22.40 mg/L			
PGSP0255	May/20/1993	09:42	4.90 mg/L	21.70 mg/L			
PGSP0256	May/21/1993	02:15	5.11 mg/L	22.60 mg/L			
PGSP0257	May/22/1993	02:15	4.97 mg/L	22.00 mg/L			
PGSP0258	May/23/1993	02:15	4.84 mg/L	21.40 mg/L			
PGSP0259	May/24/1993	02:15	4.84 mg/L	21.40 mg/L			
PGSP0260	May/26/1993	12:42	5.00 mg/L	22.10 mg/L			
PGSP0261	May/29/1993	18:50	4.56 mg/L	20.18 mg/L			
PGSP0262	Jun/01/1993	16:29	5.20 mg/L	23.01 mg/L			
PGSP0263	Jun/02/1993	04:29	5.44 mg/L	24.07 mg/L			
PGSP0264	Jun/02/1993	14:30	1.00 mg/L	4.42 mg/L			0.040 mg/L
PGSP0265	Jun/08/1993	17:14	4.83 mg/L	21.37 mg/L			
PGSP0266	Jun/16/1993	06:05	4.88 mg/L	21.59 mg/L			
PGSP0267	Jun/24/1993	09:23	4.83 mg/L	21.37 mg/L			
PGSP0268	Jun/24/1993	19:52	4.47 mg/L	19.78 mg/L			
PGSP0269	Jun/24/1993	20:52	4.56 mg/L	20.18 mg/L			
PGSP0270	Jun/24/1993	21:52	4.41 mg/L	19.51 mg/L			
PGSP0271	Jun/24/1993	22:52	4.55 mg/L	20.13 mg/L			
PGSP0272	Jun/24/1993	23:52	4.60 mg/L	20.35 mg/L			
PGSP0273	Jun/25/1993	00:52	4.57 mg/L	20.22 mg/L			
PGSP0274	Jun/25/1993	01:52	4.56 mg/L	20.18 mg/L			

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Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0275	Jun/25/1993	02:52	4.56 mg/L	20.18 mg/L			
PGSP0276	Jun/25/1993	03:52	4.53 mg/L	20.04 mg/L			
PGSP0277	Jun/25/1993	04:52	4.54 mg/L	20.09 mg/L			
PGSP0278	Jun/25/1993	07:52	4.65 mg/L	20.57 mg/L			
PGSP0279	Jun/25/1993	10:52	4.64 mg/L	20.53 mg/L			
PGSP0280	Jun/25/1993	13:52	4.55 mg/L	20.13 mg/L			
PGSP0281	Jun/25/1993	16:52	4.59 mg/L	20.31 mg/L			
PGSP0282	Jun/25/1993	19:52	4.69 mg/L	20.75 mg/L			
PGSP0283	Jun/25/1993	22:52	4.80 mg/L	21.24 mg/L			
PGSP0284	Jun/26/1993	01:52	4.49 mg/L	19.87 mg/L			
PGSP0285	Jun/26/1993	04:52	4.05 mg/L	17.92 mg/L			
PGSP0286	Jun/26/1993	07:52	3.61 mg/L	15.97 mg/L			
PGSP0287	Jun/26/1993	10:52	3.51 mg/L	15.53 mg/L			
PGSP0288	Jun/26/1993	22:52	3.83 mg/L	16.95 mg/L			
PGSP0289	Jun/27/1993	10:52	4.22 mg/L	18.67 mg/L			
PGSP0290	Jun/27/1993	22:52	4.42 mg/L	19.56 mg/L			
PGSP0291	Jun/28/1993	10:52	4.47 mg/L	19.78 mg/L			
PGSP0292	Jun/29/1993	11:00	4.43 mg/L	19.60 mg/L			0.152 mg/L
PGSP0293	Jul/02/1993	16:04	3.54 mg/L	15.66 mg/L			
PGSP0294	Jul/03/1993	13:04	4.14 mg/L	18.32 mg/L			
PGSP0295	Jul/15/1993	12:08	4.44 mg/L	19.65 mg/L			
PGSP0296	Jul/16/1993	11:30	1.00 mg/L	4.42 mg/L			
PGSP0297	Jul/22/1993	11:20	1.00 mg/L	4.42 mg/L			
PGSP0298	Jul/29/1993	09:46	5.42 mg/L	23.98 mg/L			
PGSP0299	Aug/04/1993	09:00	6.33 mg/L	28.01 mg/L			0.041 mg/L
PGSP0300	Aug/14/1993	15:53	5.49 mg/L	24.29 mg/L			
PGSP0301	Aug/24/1993	12:18	5.13 mg/L	22.70 mg/L			
PGSP0302	Sep/09/1993	07:30	5.65 mg/L	25.00 mg/L			0.030 mg/L
		Average*	4.98 mg/L	22.04 mg/L			0.078 mg/L
		Maximum	6.33 mg/L	28.01 mg/L			0.310 mg/L
		Minimum	3.51 mg/L	15.53 mg/L			0.310 mg/L
		Standard Deviation	.46	2.03			.081
		Coefficient Variation	.09	.09			1.038
Number of analyses 185							

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Spring Valley karst window, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Total Nitrate-Nitrogen (mg/L as N)*	*Total Nitrate-Nitrogen (mg/L as NO_3)*	*Ammonia, Unionized (mg/L as NH_3)*	*Total Kjeldahl Nitrogen (mg/L as N)*	*Orthophosphate (mg/L as PO_4)*
SVKW0015	May/20/1993	09:20	5.02 mg/L	22.20 mg/L			
SVKW0016	May/26/1993	12:10	5.11 mg/L	22.60 mg/L			
		Average*	5.06 mg/L	22.40 mg/L			
Number of analyses 2							

George Delaney swallow hole, October 1992–September 1993

Sample Number	*Date*	*Time (CST)*	*Total Nitrate-Nitrogen (mg/L as N)*	*Total Nitrate-Nitrogen (mg/L as NO_3)*	*Ammonia, Unionized (mg/L as NH_3)*	*Total Kjeldahl Nitrogen (mg/L as N)*	*Orthophosphate (mg/L as PO_4)*
GDSW0009	May/20/1993	08:14	6.98 mg/L	30.90 mg/L			
GDSW0010	May/26/1993	11:50	6.67 mg/L	29.50 mg/L			
GDSW0011	Jun/17/1993	08:20	5.56 mg/L	24.60 mg/L			
		Average*	6.40 mg/L	28.33 mg/L			
		Maximum	6.98 mg/L	30.90 mg/L			
		Minimum	5.56 mg/L	24.60 mg/L			
Number of analyses 3							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Leslie Page karst window, October 1992–September 1993

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
LPKW0001	Apr/10/1993	18:00	5.15 mg/L	22.80 mg/L			
LPKW0002	Apr/11/1993	06:00	5.31 mg/L	23.50 mg/L			
LPKW0003	Apr/11/1993	18:00	4.88 mg/L	21.60 mg/L			
LPKW0004	Apr/12/1993	06:00	5.09 mg/L	22.50 mg/L			
LPKW0005	Apr/12/1993	18:00	4.97 mg/L	22.00 mg/L			
LPKW0006	Apr/13/1993	06:00	5.11 mg/L	22.60 mg/L			
LPKW0007	May/05/1993	08:17	4.38 mg/L	19.40 mg/L			
LPKW0009	May/20/1993	11:10	4.86 mg/L	21.50 mg/L			
LPKW0010	May/26/1993	11:30	4.88 mg/L	21.60 mg/L			
LPKW010A	Jun/02/1993	16:50	1.00 mg/L	4.42 mg/L			
LPKW0011	Jun/08/1993	08:34	4.90 mg/L	21.68 mg/L			
LPKW0012	Jun/17/1993	09:50	4.72 mg/L	20.88 mg/L			
LPKW0013	Jun/24/1993	10:00	4.72 mg/L	20.88 mg/L			
LPKW0014	Jun/30/1993	09:45	4.49 mg/L	19.87 mg/L			
LPKW0015	Jul/15/1993	11:22	4.22 mg/L	18.67 mg/L			
LPKW0017	Jul/29/1993	10:32	5.24 mg/L	23.19 mg/L			
		Average*	4.86 mg/L	21.51 mg/L			
		Maximum	5.31 mg/L	23.50 mg/L			
		Minimum	4.22 mg/L	18.67 mg/L			
		Standard Deviation	.31	1.39			
		Coefficient Variation	.06	.06			
Number of analyses 16							

Upper Pleasant Grove Creek, October 1992–September 1993

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
UPGC0001	Jun/17/1993	07:25	8.00 mg/L	35.40 mg/L			
UPGC0002	Jun/30/1993	09:10	6.33 mg/L	28.01 mg/L			
UPGC0003	Aug/03/1993	15:33	1.81 mg/L	8.00 mg/L			
		Average*	5.38 mg/L	23.80 mg/L			
		Maximum	8.00 mg/L	35.40 mg/L			
		Minimum	1.81 mg/L	8.00 mg/L			
Number of analyses 3							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1992–September 1993

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0065	7.26 SU	478 µS	235.00 mg/L	248 mg/L	3 mg/L	0.111 mg/L
PGSP0067	7.64 SU	547 µS	241.00 mg/L	258 mg/L	3 mg/L	0.007 mg/L
PGSP0070	7.25 SU	488 µS	241.00 mg/L	300 mg/L	3 mg/L	0.006 mg/L
PGSP0071	7.16 SU	432 µS	198.00 mg/L	212 mg/L	8 mg/L	0.279 mg/L
PGSP0084				258 mg/L	8 mg/L	
PGSP0089				224 mg/L	7 mg/L	
PGSP0095				248 mg/L	6 mg/L	
PGSP0101				260 mg/L	5 mg/L	
PGSP0107				254 mg/L	7 mg/L	
PGSP0108	7.07 SU	464 µS	198.00 mg/L	254 mg/L	4 mg/L	0.122 mg/L
PGSP0109				256 mg/L	4 mg/L	
PGSP0110				264 mg/L	6 mg/L	
PGSP0111				260 mg/L	7 mg/L	
PGSP0112				286 mg/L	8 mg/L	
PGSP0113				266 mg/L	7 mg/L	
PGSP0114				262 mg/L	9 mg/L	
PGSP0115				260 mg/L	10 mg/L	
PGSP0116				258 mg/L	12 mg/L	
PGSP0117				242 mg/L	12 mg/L	
PGSP0118				244 mg/L	16 mg/L	
PGSP0119				248 mg/L	18 mg/L	
PGSP0120				256 mg/L	22 mg/L	
PGSP0121				256 mg/L	22 mg/L	
PGSP0122				252 mg/L	22 mg/L	
PGSP0123				274 mg/L	18 mg/L	
PGSP0124				266 mg/L	11 mg/L	
PGSP0125				288 mg/L	22 mg/L	
PGSP0126				266 mg/L	21 mg/L	
PGSP0127				268 mg/L	22 mg/L	
PGSP0128				274 mg/L	18 mg/L	
PGSP0129				232 mg/L	25 mg/L	
PGSP0130				238 mg/L	21 mg/L	
PGSP0131				214 mg/L	18 mg/L	
PGSP0132				230 mg/L	14 mg/L	
PGSP0133				238 mg/L	11 mg/L	
PGSP0134				246 mg/L	8 mg/L	
PGSP0135				248 mg/L	46 mg/L	
PGSP0136				270 mg/L	42 mg/L	
PGSP0137				250 mg/L	55 mg/L	

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0138				260 mg/L	64 mg/L	
PGSP0139				258 mg/L	82 mg/L	
PGSP0140				262 mg/L	76 mg/L	
PGSP0141				226 mg/L	67 mg/L	
PGSP0142				228 mg/L	72 mg/L	
PGSP0143				234 mg/L	87 mg/L	
PGSP0144				216 mg/L	82 mg/L	
PGSP0145				236 mg/L	53 mg/L	
PGSP0146				242 mg/L	68 mg/L	
PGSP0147				262 mg/L	87 mg/L	
PGSP0148				258 mg/L	96 mg/L	
PGSP0149				236 mg/L	132 mg/L	
PGSP0150				246 mg/L	176 mg/L	
PGSP0151				252 mg/L	232 mg/L	
PGSP0152				230 mg/L	240 mg/L	
PGSP0153				546 mg/L	239 mg/L	
PGSP0154				548 mg/L	226 mg/L	
PGSP0155				542 mg/L	162 mg/L	
PGSP0156				548 mg/L	116 mg/L	
PGSP0157				564 mg/L	83 mg/L	
PGSP0158				554 mg/L	66 mg/L	
PGSP0159	7.38 SU	406 µS	141.00 mg/L	222 mg/L	63 mg/L	2.930 mg/L
PGSP0161				250 mg/L	5 mg/L	
PGSP0172				268 mg/L	48 mg/L	
PGSP0176				242 mg/L	36 mg/L	
PGSP0180				240 mg/L	53 mg/L	
PGSP0181				236 mg/L	64 mg/L	
PGSP0182				228 mg/L	42 mg/L	
PGSP0183				230 mg/L	29 mg/L	
PGSP0184				226 mg/L	29 mg/L	
PGSP0185				244 mg/L	10 mg/L	
PGSP0186				242 mg/L	38 mg/L	
PGSP0187				258 mg/L	41 mg/L	
PGSP0188				248 mg/L	40 mg/L	
PGSP0189				238 mg/L	40 mg/L	
PGSP0190				242 mg/L	45 mg/L	
PGSP0191				246 mg/L	47 mg/L	
PGSP0192				238 mg/L	48 mg/L	

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Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0199				208 mg/L	167 mg/L	
PGSP0200				212 mg/L	212 mg/L	
PGSP0201				212 mg/L	211 mg/L	
PGSP0202				210 mg/L	191 mg/L	
PGSP0203				220 mg/L	174 mg/L	
PGSP0204				210 mg/L	150 mg/L	
PGSP0205				154 mg/L	130 mg/L	
PGSP0206				162 mg/L	90 mg/L	
PGSP0207				178 mg/L	72 mg/L	
PGSP0208				176 mg/L	63 mg/L	
PGSP0209				180 mg/L	56 mg/L	
PGSP0210				180 mg/L	34 mg/L	
PGSP0211	7.63 SU	395 µS	149.00 mg/L	248 mg/L	6 mg/L	0.123 mg/L
PGSP0213				272 mg/L	14 mg/L	
PGSP0214				214 mg/L	98 mg/L	
PGSP0215	7.23 SU	241 µS	98.00 mg/L	176 mg/L	201 mg/L	7.170 mg/L
PGSP0216				200 mg/L	202 mg/L	
PGSP0217				206 mg/L	162 mg/L	
PGSP0218				528 mg/L	184 mg/L	
PGSP0219				400 mg/L	164 mg/L	
PGSP0220				498 mg/L	170 mg/L	
PGSP0221				466 mg/L	156 mg/L	
PGSP0222				468 mg/L	164 mg/L	
PGSP0223				274 mg/L	146 mg/L	
PGSP0224				194 mg/L	160 mg/L	
PGSP0225				192 mg/L	134 mg/L	
PGSP0226				214 mg/L	120 mg/L	
PGSP0227				218 mg/L	108 mg/L	
PGSP0228				232 mg/L	100 mg/L	
PGSP0229				216 mg/L	160 mg/L	
PGSP0230				298 mg/L	94 mg/L	
PGSP0231				302 mg/L	86 mg/L	
PGSP0193				250 mg/L	51 mg/L	
PGSP0194				268 mg/L	53 mg/L	
PGSP0195				258 mg/L	62 mg/L	
PGSP0196				272 mg/L	89 mg/L	
PGSP0197				270 mg/L	104 mg/L	
PGSP0198				278 mg/L	135 mg/L	

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Pleasant Grove Spring, October 1992–September 1993
(Continued)

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
PGSP0232				292 mg/L	86 mg/L	
PGSP0233				310 mg/L	70 mg/L	
PGSP0234				304 mg/L	76 mg/L	
PGSP0264	7.25 SU	424 µS	195.00 mg/L	270 mg/L	11 mg/L	0.117 mg/L
PGSP0268				238 mg/L	14 mg/L	
PGSP0269				240 mg/L	12 mg/L	
PGSP0270				228 mg/L	21 mg/L	
PGSP0271				262 mg/L	10 mg/L	
PGSP0272				262 mg/L	8 mg/L	
PGSP0273				242 mg/L	10 mg/L	
PGSP0274				246 mg/L	12 mg/L	
PGSP0275				236 mg/L	15 mg/L	
PGSP0276				214 mg/L	16 mg/L	
PGSP0277				220 mg/L	22 mg/L	
PGSP0278				224 mg/L	17 mg/L	
PGSP0279				244 mg/L	27 mg/L	
PGSP0280				226 mg/L	13 mg/L	
PGSP0281				286 mg/L	16 mg/L	
PGSP0282				204 mg/L	56 mg/L	
PGSP0283				272 mg/L	28 mg/L	
PGSP0284				370 mg/L	61 mg/L	
PGSP0285				348 mg/L	69 mg/L	
PGSP0286				266 mg/L	80 mg/L	
PGSP0287				258 mg/L	74 mg/L	
PGSP0288				294 mg/L	27 mg/L	
PGSP0289				298 mg/L	8 mg/L	
PGSP0290				316 mg/L	14 mg/L	
PGSP0291				336 mg/L	8 mg/L	
PGSP0292	7.00 SU	438 µS	214.00 mg/L	258 mg/L	10 mg/L	0.166 mg/L
PGSP0299	7.15 SU	405 µS	232.00 mg/L	276 mg/L	3 mg/L	
Average*	7.27 SU	429 µS	194.73 mg/L	267 mg/L	64.36 mg/L	1.103 mg/L
Maximum	7.64 SU	547 µS	241.00 mg/L	564 mg/L	240.00 mg/L	7.170 mg/L
Minimum	7.00 SU	241 µS	98.00 mg/L	154 mg/L	3.00 mg/L	0.006 mg/L
Standard Deviation	.21	76.6	46.93	79.5	62.77	2.309
Coefficient Variation	.03	.2	.24	.3	.98	2.093
Number of analyses 145						

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Pleasant Grove Spring, October 1992–September 1993

Sample Number	*Total Calcium (mg/L as Ca)*	*Total Magnesium (mg/L as Mg)*	*Total Sodium (mg/L as Na)*	*Total Potassium (mg/L as K)*	*Bicarbonate (mg/L as HCO_3)*	*Total Sulfate (mg/L as SO_4)*	*Dissolved Chloride (mg/L as Cl)*
PGSP0065	85.00 mg/L	8.48 mg/L	2.39 mg/L	1.28 mg/L	286 mg/L	5.85 mg/L	6.15 mg/L
PGSP0067	85.20 mg/L	8.49 mg/L	2.38 mg/L	1.28 mg/L	294 mg/L	5.89 mg/L	5.46 mg/L
PGSP0070	87.40 mg/L	8.80 mg/L	2.46 mg/L	1.28 mg/L	294 mg/L	5.65 mg/L	5.67 mg/L
PGSP0071	76.20 mg/L	6.82 mg/L	2.79 mg/L	2.06 mg/L	241 mg/L	5.78 mg/L	6.50 mg/L
PGSP0108	79.40 mg/L	7.24 mg/L	2.67 mg/L	1.28 mg/L	241 mg/L	5.26 mg/L	6.19 mg/L
PGSP0159	55.30 mg/L	5.02 mg/L	0.21 mg/L	2.59 mg/L	172 mg/L	6.61 mg/L	6.23 mg/L
PGSP0211	68.50 mg/L	6.04 mg/L	2.50 mg/L	1.28 mg/L	182 mg/L	5.36 mg/L	6.86 mg/L
PGSP0215	41.20 mg/L	4.38 mg/L	1.42 mg/L	5.08 mg/L	119 mg/L	6.34 mg/L	5.33 mg/L
PGSP0299	1.00 mg/L	1.00 mg/L	1.00 mg/L	1.00 mg/L	283 mg/L	5.37 mg/L	6.09 mg/L
PGSP0302	89.40 mg/L	9.09 mg/L	2.42 mg/L	1.21 mg/L	294 mg/L	5.43 mg/L	5.76 mg/L
Average*	74.18 mg/L	7.15 mg/L	2.14 mg/L	1.93 mg/L	235.56 mg/L	5.75 mg/L	6.02 mg/L
Maximum	89.40 mg/L	9.09 mg/L	2.79 mg/L	5.08 mg/L	294.00 mg/L	6.61 mg/L	6.86 mg/L
Minimum	41.20 mg/L	4.38 mg/L	0.21 mg/L	1.21 mg/L	119.00 mg/L	5.26 mg/L	5.33 mg/L
Standard Deviation	16.40	1.72	.82	1.28	64.28	.44	.47
Coefficient Variation	.22	.24	.38	.66	.27	.08	.08
Number of analyses 10							

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Pleasant Grove Spring, October 1993–September 1994

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0303	Oct/06/1993	07:30	5.40 mg/L	23.89 mg/L			0.032 mg/L
PGSP0304	Nov/09/1993	10:45	5.01 mg/L	22.17 mg/L			0.035 mg/L
PGSP0305	Nov/18/1993	12:37	5.33 mg/L	23.58 mg/L			
PGSP0306	Dec/08/1993	09:30	7.66 mg/L	33.89 mg/L			
PGSP0307	Dec/09/1993	21:04	7.55 mg/L	33.41 mg/L			
PGSP0308	Dec/09/1993	22:04	7.50 mg/L	33.19 mg/L			
PGSP0309	Dec/09/1993	23:04	7.36 mg/L	32.57 mg/L			
PGSP0310	Dec/10/1993	00:04	7.30 mg/L	32.30 mg/L			
PGSP0311	Dec/10/1993	01:04	7.36 mg/L	32.57 mg/L			
PGSP0312	Dec/10/1993	02:04	7.27 mg/L	32.17 mg/L			
PGSP0313	Dec/10/1993	03:04	7.16 mg/L	31.68 mg/L			
PGSP0314	Dec/10/1993	04:04	7.34 mg/L	32.48 mg/L			
PGSP0315	Dec/10/1993	05:04	6.98 mg/L	30.88 mg/L			
PGSP0316	Dec/10/1993	06:04	6.82 mg/L	30.18 mg/L			
PGSP0317	Dec/10/1993	09:04	6.37 mg/L	28.19 mg/L			
PGSP0318	Dec/10/1993	12:04	5.11 mg/L	22.61 mg/L			
PGSP0319	Dec/10/1993	15:04	5.15 mg/L	22.79 mg/L			
PGSP0320	Dec/10/1993	18:04	5.60 mg/L	24.78 mg/L			
PGSP0321	Dec/10/1993	21:04	6.14 mg/L	27.17 mg/L			
PGSP0322	Dec/11/1993	00:04	6.51 mg/L	28.80 mg/L			
PGSP0323	Dec/11/1993	03:04	6.87 mg/L	30.40 mg/L			
PGSP0324	Dec/11/1993	06:04	7.16 mg/L	31.68 mg/L			
PGSP0325	Dec/11/1993	09:04	7.07 mg/L	31.28 mg/L			
PGSP0326	Dec/11/1993	12:04	7.18 mg/L	31.77 mg/L			
PGSP0327	Dec/12/1993	00:04	7.50 mg/L	33.19 mg/L			
PGSP0328	Dec/12/1993	12:04	7.77 mg/L	34.38 mg/L			
PGSP0329	Dec/13/1993	00:04	7.55 mg/L	33.41 mg/L			
PGSP0330	Dec/13/1993	12:04	7.82 mg/L	34.60 mg/L			
PGSP0332	Dec/29/1993	12:55	7.07 mg/L	31.28 mg/L			
PGSP0333	Jan/02/1994	03:55	6.84 mg/L	30.26 mg/L			
PGSP0334	Jan/12/1994	11:40	7.16 mg/L	31.68 mg/L			
PGSP0335	Jan/24/1994	17:24	4.90 mg/L	21.68 mg/L			
PGSP0336	Jan/24/1994	20:24	4.65 mg/L	20.57 mg/L			
PGSP0337	Jan/25/1994	08:24	4.88 mg/L	21.59 mg/L			
PGSP0338	Jan/25/1994	20:24	3.75 mg/L	16.59 mg/L			
PGSP0339	Jan/26/1994	08:24	5.04 mg/L	22.30 mg/L			
PGSP0340	Jan/26/1994	20:24	6.42 mg/L	28.41 mg/L			
PGSP0341	Jan/27/1994	08:50	6.66 mg/L	29.47 mg/L			
PGSP0342	Feb/02/1994	12:10	7.34 mg/L	32.48 mg/L			
PGSP0343	Feb/22/1994	11:20	7.05 mg/L	31.19 mg/L			0.053 mg/L

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0344	Mar/01/1994	11:00	7.05 mg/L	31.19 mg/L			
PGSP0345	Mar/09/1994	09:00	3.82 mg/L	16.90 mg/L			
PGSP0346	Mar/15/1994	15:57	6.82 mg/L	30.18 mg/L			
PGSP0347	Mar/27/1994	05:30	5.47 mg/L	24.20 mg/L			
PGSP0348	Mar/27/1994	06:10	5.81 mg/L	25.71 mg/L			
PGSP0349	Mar/27/1994	06:50	3.75 mg/L	16.59 mg/L			
PGSP0350	Mar/27/1994	07:30	3.14 mg/L	13.89 mg/L			
PGSP0351	Mar/27/1994	08:10	2.96 mg/L	13.10 mg/L			
PGSP0352	Mar/27/1994	09:30	2.76 mg/L	12.21 mg/L			
PGSP0353	Mar/27/1994	11:30	3.12 mg/L	13.81 mg/L			
PGSP0354	Mar/27/1994	13:30	3.43 mg/L	15.18 mg/L			
PGSP0355	Mar/27/1994	14:30	3.46 mg/L	15.31 mg/L			
PGSP0356	Mar/27/1994	15:30	3.66 mg/L	16.19 mg/L			
PGSP0357	Mar/27/1994	16:30	3.84 mg/L	16.99 mg/L			
PGSP0358	Mar/27/1994	17:30	3.98 mg/L	17.61 mg/L			
PGSP0359	Mar/27/1994	18:30	4.04 mg/L	17.88 mg/L			
PGSP0360	Mar/27/1994	22:30	4.38 mg/L	19.38 mg/L			
PGSP0361	Mar/28/1994	02:30	3.91 mg/L	17.30 mg/L			
PGSP0362	Mar/28/1994	06:30	4.16 mg/L	18.41 mg/L			
PGSP0363	Mar/28/1994	10:30	4.65 mg/L	20.57 mg/L			
PGSP0364	Mar/28/1994	13:30	4.95 mg/L	21.90 mg/L			0.138 mg/L
PGSP0365	Mar/28/1994	18:00	5.35 mg/L	23.67 mg/L			
PGSP0366	Mar/29/1994	06:00	5.47 mg/L	24.20 mg/L			
PGSP0367	Mar/29/1994	18:00	5.74 mg/L	25.40 mg/L			
PGSP0368	Mar/30/1994	06:00	5.90 mg/L	26.11 mg/L			
PGSP0369	Mar/30/1994	18:00	6.23 mg/L	27.57 mg/L			
PGSP0370	Mar/31/1994	06:00	6.23 mg/L	27.57 mg/L			
PGSP0371	Mar/31/1994	18:00	5.81 mg/L	25.71 mg/L			
PGSP0372	Apr/01/1994	06:00	6.30 mg/L	27.88 mg/L			
PGSP0373	Apr/01/1994	18:00	5.58 mg/L	24.69 mg/L			
PGSP0374	Apr/02/1994	06:00	6.12 mg/L	27.08 mg/L			
PGSP0375	Apr/02/1994	18:00	6.28 mg/L	27.79 mg/L			
PGSP0376	Apr/03/1994	06:00	6.23 mg/L	27.57 mg/L			
PGSP0377	Apr/03/1994	18:00	6.30 mg/L	27.88 mg/L			
PGSP0378	Apr/04/1994	06:00	5.99 mg/L	26.50 mg/L			
PGSP0379	Apr/04/1994	18:00	6.35 mg/L	28.10 mg/L			
PGSP0380	Apr/05/1994	06:00	6.23 mg/L	27.57 mg/L			
PGSP0381	Apr/05/1994	18:00	6.28 mg/L	27.79 mg/L			
PGSP0382	Apr/06/1994	06:00	5.58 mg/L	24.69 mg/L			

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0388	Apr/11/1994	17:57	3.14 mg/L	13.89 mg/L			
PGSP0389	Apr/12/1994	07:30	5.38 mg/L	23.80 mg/L			
PGSP0391	Apr/12/1994	15:30	5.67 mg/L	25.09 mg/L			
PGSP0392	Apr/13/1994	06:15	5.65 mg/L	25.00 mg/L			
PGSP0393	Apr/13/1994	18:00	6.10 mg/L	26.99 mg/L			
PGSP0394	Apr/14/1994	06:00	6.17 mg/L	27.30 mg/L			
PGSP0395	Apr/14/1994	18:00	6.28 mg/L	27.79 mg/L			
PGSP0396	Apr/15/1994	06:00	6.23 mg/L	27.57 mg/L			
PGSP0397	Apr/15/1994	18:00	4.99 mg/L	22.08 mg/L			
PGSP0398	Apr/16/1994	06:00	5.08 mg/L	22.48 mg/L			
PGSP0399	Apr/16/1994	18:00	5.78 mg/L	25.57 mg/L			
PGSP0400	Apr/17/1994	06:00	6.05 mg/L	26.77 mg/L			
PGSP0401	Apr/17/1994	18:00	6.26 mg/L	27.70 mg/L			
PGSP0402	Apr/18/1994	06:00	6.12 mg/L	27.08 mg/L			
PGSP0403	Apr/18/1994	18:00	6.10 mg/L	26.99 mg/L			
PGSP0404	Apr/19/1994	06:00	6.08 mg/L	26.90 mg/L			
PGSP404A	Apr/20/1994	06:00	4.27 mg/L	18.89 mg/L			
PGSP0405	Apr/21/1994	06:00	4.77 mg/L	21.11 mg/L			
PGSP0406	Apr/22/1994	06:00	4.43 mg/L	19.60 mg/L			
PGSP0407	Apr/23/1994	06:00	4.34 mg/L	19.20 mg/L			
PGSP0408	Apr/24/1994	06:00	4.04 mg/L	17.88 mg/L			
PGSP0409	Apr/25/1994	06:00	4.25 mg/L	18.80 mg/L			
PGSP0410	Apr/26/1994	06:00	4.02 mg/L	17.79 mg/L			
PGSP0411	Apr/27/1994	06:00	4.09 mg/L	18.10 mg/L			
PGSP0412	Apr/27/1994	10:00	4.11 mg/L	18.19 mg/L			0.509 mg/L
PGSP0413	Apr/28/1994	06:00	3.91 mg/L	17.30 mg/L			
PGSP0414	Apr/29/1994	06:00	3.98 mg/L	17.61 mg/L			
PGSP0415	Apr/29/1994	18:00	4.00 mg/L	17.70 mg/L			
PGSP0416	Apr/29/1994	18:45	4.77 mg/L	21.11 mg/L			
PGSP0417	Apr/29/1994	19:05	4.36 mg/L	19.29 mg/L			
PGSP0418	Apr/29/1994	19:09	4.61 mg/L	20.40 mg/L			
PGSP0419	Apr/29/1994	19:25	4.52 mg/L	20.00 mg/L			
PGSP0420	Apr/29/1994	19:45	4.54 mg/L	20.09 mg/L			
PGSP0421	Apr/29/1994	19:51	4.61 mg/L	20.40 mg/L			
PGSP0422	Apr/29/1994	20:05	4.70 mg/L	20.80 mg/L			
PGSP0383	Apr/06/1994	18:00	5.87 mg/L	25.97 mg/L			
PGSP0384	Apr/07/1994	06:00	6.12 mg/L	27.08 mg/L			
PGSP0385	Apr/07/1994	14:00	6.14 mg/L	27.17 mg/L			
PGSP0387	Apr/11/1994	14:13	2.37 mg/L	10.49 mg/L			

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0423	Apr/29/1994	20:25	4.59 mg/L	20.31 mg/L			
PGSP0424	Apr/29/1994	20:45	4.38 mg/L	19.38 mg/L			
PGSP0425	Apr/29/1994	21:05	4.47 mg/L	19.78 mg/L			
PGSP0426	Apr/29/1994	21:25	4.07 mg/L	18.01 mg/L			
PGSP0427	Apr/29/1994	21:45	3.89 mg/L	17.21 mg/L			
PGSP0428	Apr/29/1994	22:45	4.20 mg/L	18.58 mg/L			
PGSP0429	Apr/29/1994	23:45	3.70 mg/L	16.37 mg/L			
PGSP0430	Apr/30/1994	00:45	3.52 mg/L	15.57 mg/L			
PGSP0431	Apr/30/1994	01:45	3.32 mg/L	14.69 mg/L			
PGSP0432	Apr/30/1994	02:45	3.09 mg/L	13.67 mg/L			
PGSP0433	Apr/30/1994	03:45	3.05 mg/L	13.50 mg/L			
PGSP0434	Apr/30/1994	04:45	3.19 mg/L	14.11 mg/L			
PGSP0435	Apr/30/1994	05:45	3.16 mg/L	13.98 mg/L			
PGSP0436	Apr/30/1994	06:45	3.32 mg/L	14.69 mg/L			
PGSP0437	Apr/30/1994	07:45	3.39 mg/L	15.00 mg/L			
PGSP0438	Apr/30/1994	11:45	3.68 mg/L	16.28 mg/L			
PGSP0439	Apr/30/1994	15:45	4.07 mg/L	18.01 mg/L			
PGSP0440	May/01/1994	06:00	4.27 mg/L	18.89 mg/L			
PGSP0441	May/02/1994	06:00	4.61 mg/L	20.40 mg/L			
PGSP0442	May/03/1994	06:00	4.09 mg/L	18.10 mg/L			
PGSP0443	May/04/1994	06:00	4.38 mg/L	19.38 mg/L			
PGSP0444	May/04/1994	18:00	4.34 mg/L	19.20 mg/L			
PGSP0445	May/05/1994	06:00	4.34 mg/L	19.20 mg/L			
PGSP0446	May/07/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0447	May/09/1994	06:00	4.47 mg/L	19.78 mg/L			
PGSP0448	May/11/1994	06:00	4.36 mg/L	19.29 mg/L			
PGSP0449	May/12/1994	09:00	4.36 mg/L	19.29 mg/L			
PGSP0450	May/13/1994	06:00	4.20 mg/L	18.58 mg/L			
PGSP0451	May/14/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0452	May/15/1994	06:00	3.98 mg/L	17.61 mg/L			
PGSP0453	May/15/1994	18:00	4.29 mg/L	18.98 mg/L			
PGSP0454	May/16/1994	06:00	4.04 mg/L	17.88 mg/L			
PGSP0455	May/17/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0456	May/18/1994	06:00	4.41 mg/L	19.51 mg/L			
PGSP0457	May/20/1994	06:00	4.45 mg/L	19.69 mg/L			
PGSP0458	May/22/1994	06:00	4.34 mg/L	19.20 mg/L			
PGSP0459	May/24/1994	06:00	4.29 mg/L	18.98 mg/L			
PGSP0460	May/26/1994	06:00	4.29 mg/L	18.98 mg/L			
PGSP0461	May/28/1994	06:00	3.95 mg/L	17.48 mg/L			

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0462	May/30/1994	06:00	4.25 mg/L	18.80 mg/L			
PGSP0463	Jun/01/1994	12:00	4.20 mg/L	18.58 mg/L			
PGSP0464	Jun/03/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0465	Jun/05/1994	06:00	3.84 mg/L	16.99 mg/L			
PGSP0466	Jun/07/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0467	Jun/09/1994	06:00	4.43 mg/L	19.60 mg/L			
PGSP0468	Jun/10/1994	06:00	4.59 mg/L	20.31 mg/L			
PGSP0469	Jun/10/1994	11:01	4.74 mg/L	20.97 mg/L			
PGSP0470	Jun/10/1994	11:21	4.70 mg/L	20.80 mg/L			
PGSP0471	Jun/10/1994	11:41	4.72 mg/L	20.88 mg/L			
PGSP0472	Jun/10/1994	12:01	4.65 mg/L	20.57 mg/L			
PGSP0473	Jun/10/1994	12:21	4.65 mg/L	20.57 mg/L			
PGSP0474	Jun/10/1994	12:41	4.72 mg/L	20.88 mg/L			
PGSP0475	Jun/10/1994	13:01	4.65 mg/L	20.57 mg/L			
PGSP0476	Jun/10/1994	13:21	4.74 mg/L	20.97 mg/L			
PGSP0477	Jun/10/1994	13:41	4.63 mg/L	20.49 mg/L			
PGSP0478	Jun/10/1994	14:01	4.70 mg/L	20.80 mg/L			
PGSP0479	Jun/10/1994	15:01	4.36 mg/L	19.29 mg/L			
PGSP0480	Jun/10/1994	16:01	4.74 mg/L	20.97 mg/L			
PGSP0481	Jun/10/1994	17:01	4.65 mg/L	20.57 mg/L			
PGSP0482	Jun/10/1994	18:01	4.70 mg/L	20.80 mg/L			
PGSP0483	Jun/10/1994	19:01	4.61 mg/L	20.40 mg/L			
PGSP0484	Jun/10/1994	20:01	4.63 mg/L	20.49 mg/L			
PGSP0485	Jun/10/1994	21:01	4.68 mg/L	20.71 mg/L			
PGSP0486	Jun/10/1994	22:01	4.65 mg/L	20.57 mg/L			
PGSP0487	Jun/10/1994	23:01	4.61 mg/L	20.40 mg/L			
PGSP0488	Jun/11/1994	00:01	4.61 mg/L	20.40 mg/L			
PGSP0489	Jun/11/1994	04:01	4.61 mg/L	20.40 mg/L			
PGSP0490	Jun/11/1994	06:00	4.13 mg/L	18.27 mg/L			
PGSP0491	Jun/11/1994	08:01	4.56 mg/L	20.18 mg/L			
PGSP0492	Jun/11/1994	12:01	4.50 mg/L	19.91 mg/L			
PGSP0493	Jun/11/1994	16:01	4.52 mg/L	20.00 mg/L			
PGSP0494	Jun/14/1994	06:00	4.52 mg/L	20.00 mg/L			
PGSP0495	Jun/16/1994	06:00	4.11 mg/L	18.19 mg/L			
PGSP0496	Jun/17/1994	06:00	4.18 mg/L	18.50 mg/L			
PGSP0497	Jun/17/1994	21:13	4.59 mg/L	20.31 mg/L			
PGSP0498	Jun/17/1994	21:33	4.63 mg/L	20.49 mg/L			
PGSP0499	Jun/17/1994	21:53	4.65 mg/L	20.57 mg/L			
PGSP0500	Jun/17/1994	22:13	4.63 mg/L	20.49 mg/L			

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0501	Jun/17/1994	22:33	4.59 mg/L	20.31 mg/L			
PGSP0502	Jun/17/1994	22:53	4.65 mg/L	20.57 mg/L			
PGSP0503	Jun/17/1994	23:13					
PGSP0504	Jun/17/1994	23:33	4.72 mg/L	20.88 mg/L			
PGSP0505	Jun/17/1994	23:53	4.81 mg/L	21.28 mg/L			
PGSP0506	Jun/18/1994	00:13	4.70 mg/L	20.80 mg/L			
PGSP0507	Jun/18/1994	01:13	4.79 mg/L	21.19 mg/L			
PGSP0508	Jun/18/1994	02:13	4.25 mg/L	18.80 mg/L			
PGSP0509	Jun/18/1994	03:13	3.23 mg/L	14.29 mg/L			
PGSP0510	Jun/18/1994	04:13	3.23 mg/L	14.29 mg/L			
PGSP0511	Jun/18/1994	05:13	3.37 mg/L	14.91 mg/L			
PGSP0512	Jun/18/1994	06:13	3.39 mg/L	15.00 mg/L			
PGSP0513	Jun/18/1994	07:13	3.50 mg/L	15.49 mg/L			
PGSP0514	Jun/18/1994	08:13	3.57 mg/L	15.80 mg/L			
PGSP0515	Jun/18/1994	09:13	3.52 mg/L	15.57 mg/L			
PGSP0516	Jun/18/1994	10:13	3.59 mg/L	15.88 mg/L			
PGSP0517	Jun/18/1994	14:13	3.50 mg/L	15.49 mg/L			
PGSP0518	Jun/18/1994	18:13	3.48 mg/L	15.40 mg/L			
PGSP0519	Jun/18/1994	22:13	3.66 mg/L	16.19 mg/L			
PGSP0520	Jun/19/1994	02:13	3.75 mg/L	16.59 mg/L			
PGSP0521	Jun/20/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0522	Jun/22/1994	06:00	4.07 mg/L	18.01 mg/L			
PGSP0523	Jun/24/1994	06:00	4.09 mg/L	18.10 mg/L			
PGSP0524	Jun/26/1994	06:00	4.16 mg/L	18.41 mg/L			
PGSP0525	Jun/29/1994	06:00	4.16 mg/L	18.41 mg/L			
PGSP0526	Jul/01/1994	06:00	4.27 mg/L	18.89 mg/L			
PGSP0527	Jul/03/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0528	Jul/05/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0529	Jul/06/1994	10:30	4.41 mg/L	19.51 mg/L			
PGSP0530	Jul/07/1994	06:00	4.16 mg/L	18.41 mg/L			
PGSP0531	Jul/07/1994	06:30	3.95 mg/L	17.48 mg/L			
PGSP0532	Jul/07/1994	07:10	3.68 mg/L	16.28 mg/L			
PGSP0533	Jul/07/1994	11:30	2.67 mg/L	11.81 mg/L			
PGSP0534	Jul/13/1994	06:00	4.22 mg/L	18.67 mg/L			
PGSP0535	Jul/20/1994	06:00	4.45 mg/L	19.69 mg/L			
PGSP0537	Jul/25/1994	18:38	4.29 mg/L	18.98 mg/L			
PGSP0538	Aug/03/1994	08:30	4.27 mg/L	18.89 mg/L			
PGSP0539	Aug/16/1994	10:00	4.16 mg/L	18.41 mg/L			
PGSP0540	Sep/08/1994	08:20	3.86 mg/L	17.08 mg/L			

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
PGSP0541	Sep/19/1994	13:50	3.82 mg/L	16.90 mg/L			
		Average*	4.86 mg/L	21.50 mg/L			0.153 mg/L
		Maximum	7.82 mg/L	34.60 mg/L			0.509 mg/L
		Minimum	2.37 mg/L	10.49 mg/L			0.053 mg/L
		Standard Deviation	1.20	5.30			.203
		Coefficient Variation	.25	.25			1.326
Total of 236 analyses for Pleasant Grove Spring							

George Delaney swallow hole, October 1993–September 1994

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
GDSW0012	Dec/07/1993	11:40	10.40 mg/L	46.02 mg/L			
GDSW0013	Mar/28/1994	10:40	5.69 mg/L	25.18 mg/L			
GDSW0014	Apr/07/1994	15:00	7.77 mg/L	34.38 mg/L			
GDSW0015	Apr/20/1994	12:10	7.79 mg/L	34.47 mg/L			
GDSW0016	Apr/26/1994	15:30	5.35 mg/L	23.67 mg/L			
GDSW0017	May/12/1994	09:50	5.72 mg/L	25.31 mg/L			
GDSW0018	May/17/1994	13:28	5.60 mg/L	24.78 mg/L			
GDSW0019	Jun/01/1994	07:36	5.42 mg/L	23.98 mg/L			
GDSW0020	Jun/15/1994	00:20	4.70 mg/L	20.80 mg/L			
GDSW0021	Jul/06/1994	09:45	4.88 mg/L	21.59 mg/L			
		Average*	6.33 mg/L	28.02 mg/L			
		Maximum	10.40 mg/L	46.02 mg/L			
		Minimum	4.70 mg/L	20.80 mg/L			
		Standard Deviation	1.78	7.89			
		Coefficient Variation	.28	.28			
Total of 10 analyses for George Delaney swallow hole							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Leslie Page karst window, October 1993–September 1994

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
LPKW0020	Nov/09/1993	09:35	5.42 mg/L	23.98 mg/L			
LPKW0021	Dec/07/1993	16:53	5.90 mg/L	26.11 mg/L			
LPKW0022	Jan/11/1994	14:23	6.37 mg/L	28.19 mg/L			
LPKW0023	Feb/02/1994	09:55	7.34 mg/L	32.48 mg/L			
LPKW0024	Feb/22/1994	13:30	7.43 mg/L	32.88 mg/L			0.035 mg/L
LPKW0026	Mar/10/1994	19:23	8.79 mg/L	38.89 mg/L			
LPKW0027	Mar/10/1994	19:43	8.22 mg/L	36.37 mg/L			
LPKW0028	Mar/10/1994	20:03	8.09 mg/L	35.80 mg/L			
LPKW0029	Mar/10/1994	20:23	8.20 mg/L	36.28 mg/L			
LPKW0030	Mar/10/1994	20:43	8.22 mg/L	36.37 mg/L			
LPKW0031	Mar/10/1994	21:03	8.09 mg/L	35.80 mg/L			
LPKW0032	Mar/10/1994	21:23	8.79 mg/L	38.89 mg/L			
LPKW0033	Mar/10/1994	21:43	7.88 mg/L	34.87 mg/L			
LPKW0034	Mar/10/1994	22:03	7.86 mg/L	34.78 mg/L			
LPKW0035	Mar/10/1994	22:23	7.88 mg/L	34.87 mg/L			
LPKW0036	Mar/10/1994	23:23	7.86 mg/L	34.78 mg/L			
LPKW0037	Mar/11/1994	00:23	8.49 mg/L	37.57 mg/L			
LPKW0038	Mar/11/1994	01:23	7.91 mg/L	35.00 mg/L			
LPKW0039	Mar/11/1994	02:23	8.02 mg/L	35.49 mg/L			
LPKW0040	Mar/11/1994	03:23	7.95 mg/L	35.18 mg/L			
LPKW0041	Mar/11/1994	04:23	8.65 mg/L	38.27 mg/L			
LPKW0042	Mar/11/1994	05:23	8.02 mg/L	35.49 mg/L			
LPKW0043	Mar/11/1994	06:23	8.02 mg/L	35.49 mg/L			
LPKW0044	Mar/11/1994	07:23	8.18 mg/L	36.19 mg/L			
LPKW0045	Mar/11/1994	08:23	8.65 mg/L	38.27 mg/L			
LPKW0046	Mar/11/1994	12:23	8.63 mg/L	38.19 mg/L			
LPKW0047	Mar/11/1994	16:23	8.61 mg/L	38.10 mg/L			
LPKW0048	Mar/11/1994	20:23	8.72 mg/L	38.58 mg/L			
LPKW0049	Mar/12/1994	00:23	8.67 mg/L	38.36 mg/L			
LPKW0050	Mar/15/1994	17:10	7.70 mg/L	34.07 mg/L			
LPKW0051	Mar/27/1994	15:50	7.32 mg/L	32.39 mg/L			
LPKW0052	Mar/28/1994	09:10	7.79 mg/L	34.47 mg/L			
LPKW0053	Mar/28/1994	09:30	6.75 mg/L	29.87 mg/L			
LPKW0054	Mar/28/1994	09:50	7.68 mg/L	33.98 mg/L			
LPKW0055	Mar/28/1994	10:10	7.86 mg/L	34.78 mg/L			
LPKW0056	Mar/28/1994	10:30	7.61 mg/L	33.67 mg/L			
LPKW0057	Mar/28/1994	10:50	7.86 mg/L	34.78 mg/L			
LPKW0058	Mar/28/1994	11:10	7.77 mg/L	34.38 mg/L			
LPKW0059	Mar/28/1994	11:30	7.55 mg/L	33.41 mg/L			
LPKW0060	Mar/28/1994	11:50	7.59 mg/L	33.58 mg/L			

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Leslie Page karst window, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
LPKW0061	Mar/28/1994	12:10	7.73 mg/L	34.20 mg/L			
LPKW0062	Mar/28/1994	12:30	7.73 mg/L	34.20 mg/L			
LPKW0063	Mar/28/1994	13:30	7.59 mg/L	33.58 mg/L			
LPKW0064	Mar/28/1994	14:30	7.88 mg/L	34.90 mg/L			
LPKW0065	Mar/28/1994	15:30	7.93 mg/L	35.09 mg/L			
LPKW0066	Mar/28/1994	16:30	7.75 mg/L	34.29 mg/L			
LPKW0067	Mar/28/1994	17:30	7.79 mg/L	34.47 mg/L			
LPKW0068	Mar/28/1994	18:30	7.86 mg/L	34.78 mg/L			
LPKW0069	Mar/28/1994	19:30	7.68 mg/L	33.98 mg/L			
LPKW0070	Mar/28/1994	20:30	7.73 mg/L	34.20 mg/L			
LPKW0071	Mar/28/1994	21:30	7.77 mg/L	34.38 mg/L			
LPKW0072	Mar/28/1994	22:30	7.79 mg/L	34.47 mg/L			
LPKW0073	Mar/29/1994	02:30	7.86 mg/L	34.78 mg/L			
LPKW0074	Mar/29/1994	06:30	7.84 mg/L	34.69 mg/L			
LPKW0075	Mar/29/1994	10:30	7.88 mg/L	34.87 mg/L			
LPKW0076	Mar/29/1994	14:30	7.59 mg/L	33.58 mg/L			
LPKW0077	Apr/07/1994	10:55	6.94 mg/L	30.71 mg/L			
LPKW0078	Apr/12/1994	08:06	8.38 mg/L	37.08 mg/L			
LPKW0079	Apr/20/1994	08:15	7.52 mg/L	33.27 mg/L			
LPKW0080	Apr/27/1994	08:31	4.54 mg/L	20.09 mg/L			
LPKW0081	May/02/1994	12:23	5.20 mg/L	23.01 mg/L			
LPKW0082	May/03/1994	06:00	5.04 mg/L	22.30 mg/L			
LPKW0083	May/04/1994	06:00	5.01 mg/L	22.17 mg/L			
LPKW0088	May/09/1994	06:00	5.35 mg/L	23.67 mg/L			
LPKW0089	May/11/1994	06:00	5.33 mg/L	23.58 mg/L			
LPKW0090	May/12/1994	10:40	5.31 mg/L	23.50 mg/L			
LPKW0091	May/13/1994	06:00	5.42 mg/L	23.98 mg/L			
LPKW0092	May/14/1994	06:00	5.33 mg/L	23.58 mg/L			
LPKW0093	May/15/1994	06:00	5.31 mg/L	23.50 mg/L			
LPKW0094	May/16/1994	06:00	5.24 mg/L	23.19 mg/L			
LPKW0095	May/17/1994	06:00	5.33 mg/L	23.58 mg/L			
LPKW0096	May/18/1994	06:00	5.26 mg/L	23.27 mg/L			
LPKW0097	May/20/1994	06:00	5.15 mg/L	22.79 mg/L			
LPKW0098	May/22/1994	06:00	5.15 mg/L	22.79 mg/L			
LPKW0099	May/24/1994	06:00	5.15 mg/L	22.79 mg/L			
LPKW0100	May/25/1994	10:45	5.04 mg/L	22.30 mg/L			
LPKW0101	May/27/1994	10:45	5.13 mg/L	22.70 mg/L			
LPKW0102	May/29/1994	10:45	5.01 mg/L	22.17 mg/L			
LPKW0103	May/31/1994	10:45	4.92 mg/L	21.77 mg/L			

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Leslie Page karst window, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
LPKW0104	Jun/01/1994	08:30	4.72 mg/L	20.88 mg/L			
LPKW0105	Jun/15/1994	11:35	4.92 mg/L	21.77 mg/L			
LPKW0106	Jun/27/1994	23:50	4.77 mg/L	21.11 mg/L			
LPKW0107	Jun/28/1994	07:50	4.54 mg/L	20.09 mg/L			
LPKW0108	Jun/29/1994	07:50	4.61 mg/L	20.40 mg/L			
LPKW0109	Aug/02/1994	14:20	4.31 mg/L	19.07 mg/L			
		Average*	6.90 mg/L	30.53 mg/L			0.035 mg/L
		Maximum	8.79 mg/L	38.89 mg/L			0.035 mg/L
		Minimum	4.31 mg/L	19.07 mg/L			0.035 mg/L
		Standard Deviation	1.50	6.65			
		Coefficient Variation	.22	.22			
Total of 85 analyses for Leslie Page karst window							

Upper Pleasant Grove Creek, October 1993–September 1994

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
UPGC0004	Nov/18/1993	11:31	8.43 mg/L	37.30 mg/L			
UPGC0005	Dec/07/1993	15:10	10.80 mg/L	47.79 mg/L			
UPGC0006	Feb/22/1994	15:16	7.30 mg/L	32.30 mg/L			
UPGC0007	Mar/28/1994	11:05	5.60 mg/L	24.78 mg/L			
UPGC0008	Apr/07/1994	10:25	8.04 mg/L	35.57 mg/L			
UPGC0009	Apr/20/1994	12:25	7.77 mg/L	34.38 mg/L			
UPGC0010	Apr/27/1994	07:10	5.62 mg/L	24.87 mg/L			
UPGC0011	May/13/1994	10:10	6.01 mg/L	26.59 mg/L			
UPGC0012	May/17/1994	12:13	5.65 mg/L	25.00 mg/L			
UPGC0013	Jun/01/1994	07:07	6.96 mg/L	30.80 mg/L			
UPGC0014	Jun/15/1994	11:00	7.39 mg/L	32.70 mg/L			
UPGC0015	Jul/06/1994	07:30	6.73 mg/L	29.78 mg/L			
		Average*	7.19 mg/L	31.82 mg/L			
		Maximum	10.80 mg/L	47.79 mg/L			
		Minimum	5.60 mg/L	24.78 mg/L			
		Standard Deviation	1.50	6.63			
		Coefficient Variation	.21	.21			
Total of 12 analyses for Upper Pleasant Grove Creek							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Miller Schoolhouse water well, October 1993–September 1994

Sample Number	Date	Time (CST)	Total Nitrate-Nitrogen (mg/L as N)	Total Nitrate-Nitrogen (mg/L as NO_3)	Ammonia, Unionized (mg/L as NH_3)	Total Kjeldahl Nitrogen (mg/L as N)	Orthophosphate (mg/L as PO_4)
MSHW0001	Apr/26/1994	14:00	1.45 mg/L	6.42 mg/L			0.766 mg/L
Total of 1 analyses for Miller Schoolhouse Water Well							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0303	6.82 SU	503 µS		296 mg/L	5 mg/L	0.048 mg/L
PGSP0304	7.36 SU	508 µS		302 mg/L	4 mg/L	0.006 mg/L
PGSP0307				276 mg/L	7 mg/L	
PGSP0312				278 mg/L	17 mg/L	
PGSP0317				278 mg/L	205 mg/L	
PGSP0326				258 mg/L	14 mg/L	
PGSP0328				256 mg/L	8 mg/L	
PGSP0330				260 mg/L	3 mg/L	
PGSP0335				144 mg/L	44 mg/L	
PGSP0336				178 mg/L	143 mg/L	
PGSP0337				156 mg/L	51 mg/L	
PGSP0338				152 mg/L	293 mg/L	
PGSP0339				174 mg/L	123 mg/L	
PGSP0340				206 mg/L	98 mg/L	
PGSP0341				218 mg/L	65 mg/L	
PGSP0343	6.75 SU	352 µS		222 mg/L	44 mg/L	0.857 mg/L
PGSP0345				140 mg/L	140 mg/L	
PGSP0346				196 mg/L	196 mg/L	
PGSP0347				226 mg/L	176 mg/L	
PGSP0349				180 mg/L	527 mg/L	
PGSP0350				212 mg/L	427 mg/L	
PGSP0351				220 mg/L	373 mg/L	
PGSP0352				206 mg/L	255 mg/L	
PGSP0353				186 mg/L	214 mg/L	
PGSP0355				198 mg/L	186 mg/L	
PGSP0356				186 mg/L	159 mg/L	
PGSP0357				204 mg/L	147 mg/L	
PGSP0358				210 mg/L	192 mg/L	
PGSP0359				128 mg/L	153 mg/L	
PGSP0360				162 mg/L	163 mg/L	

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994
(Continued)

Sample Number	*Laboratory pH*	*Laboratory Specific Conductance (25°C)*	*Total Alkalinity (mg/L as $CaCO_3$)*	*Dissolved Solids Residue on Evaporation (mg/L 180°C)*	*Suspended Solids Residue on Evaporation (mg/L 180°C)*	*Total Iron (mg/L as Fe)*
PGSP0361				184 mg/L	127 mg/L	
PGSP0362				180 mg/L	59 mg/L	
PGSP0363				180 mg/L	67 mg/L	
PGSP0364				250 mg/L	85 mg/L	2.360 mg/L
PGSP0365				204 mg/L	75 mg/L	
PGSP0366				228 mg/L	40 mg/L	
PGSP0367				216 mg/L	52 mg/L	
PGSP0368				228 mg/L	46 mg/L	
PGSP0369				228 mg/L	38 mg/L	
PGSP0370				222 mg/L	33 mg/L	
PGSP0371				230 mg/L	32 mg/L	
PGSP0372				228 mg/L	29 mg/L	
PGSP0373				332 mg/L	28 mg/L	
PGSP0374				238 mg/L	36 mg/L	
PGSP0375				244 mg/L	29 mg/L	
PGSP0376				224 mg/L	27 mg/L	
PGSP0377				248 mg/L	33 mg/L	
PGSP0378				238 mg/L	24 mg/L	
PGSP0379				186 mg/L	23 mg/L	
PGSP0380				182 mg/L	24 mg/L	
PGSP0381				188 mg/L	24 mg/L	
PGSP0382				166 mg/L	37 mg/L	
PGSP0383				174 mg/L	31 mg/L	
PGSP0384				180 mg/L	19 mg/L	
PGSP0387				162 mg/L		
PGSP0388				178 mg/L		
PGSP0389				202 mg/L		
PGSP0391				200 mg/L		
PGSP0392				206 mg/L		
PGSP0393				232 mg/L	139 mg/L	
PGSP0394				238 mg/L	93 mg/L	
PGSP0395				234 mg/L	67 mg/L	
PGSP0396				212 mg/L	90 mg/L	
PGSP0397				202 mg/L	290 mg/L	
PGSP0398				222 mg/L	81 mg/L	
PGSP0399				220 mg/L	44 mg/L	
PGSP0400				218 mg/L	52 mg/L	
PGSP0401				250 mg/L	47 mg/L	

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994
(Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0402				236 mg/L	46 mg/L	
PGSP0403				242 mg/L	49 mg/L	
PGSP0404				234 mg/L	45 mg/L	
PGSP0412	7.20 SU	356 µS		216 mg/L	4 mg/L	0.419 mg/L
PGSP0416				244 mg/L	99 mg/L	
PGSP0417				240 mg/L	98 mg/L	
PGSP0418				242 mg/L	101 mg/L	
PGSP0419				244 mg/L	94 mg/L	
PGSP0420				232 mg/L	94 mg/L	
PGSP0421				244 mg/L	107 mg/L	
PGSP0422				248 mg/L	120 mg/L	
PGSP0423				242 mg/L	146 mg/L	
PGSP0424				238 mg/L	224 mg/L	
PGSP0425				280 mg/L	299 mg/L	
PGSP0426				274 mg/L	391 mg/L	
PGSP0427				262 mg/L	518 mg/L	
PGSP0428				230 mg/L	1827 mg/L	
PGSP0429				204 mg/L	2278 mg/L	
PGSP0430				212 mg/L	1700 mg/L	
PGSP0431				210 mg/L	1061 mg/L	
PGSP0432				186 mg/L	682 mg/L	
PGSP0433				230 mg/L	478 mg/L	
PGSP0434				226 mg/L	421 mg/L	
PGSP0435				200 mg/L	407 mg/L	
PGSP0436				202 mg/L	318 mg/L	
PGSP0437				218 mg/L	272 mg/L	
PGSP0438				286 mg/L	138 mg/L	
PGSP0439				242 mg/L	74 mg/L	
PGSP0443				254 mg/L	33 mg/L	
PGSP0445				640 mg/L	28 mg/L	
PGSP0448				20 mg/L		
PGSP0469				236 mg/L	28 mg/L	
PGSP0470				226 mg/L	15 mg/L	
PGSP0471				240 mg/L	15 mg/L	
PGSP0472				128 mg/L	11 mg/L	
PGSP0473				210 mg/L	11 mg/L	
PGSP0474				242 mg/L	10 mg/L	
PGSP0475				234 mg/L	10 mg/L	

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0476				242 mg/L	9 mg/L	
PGSP0477				248 mg/L	10 mg/L	
PGSP0478				232 mg/L	13 mg/L	
PGSP0479				246 mg/L	15 mg/L	
PGSP0480				242 mg/L	14 mg/L	
PGSP0481				262 mg/L	11 mg/L	
PGSP0482				250 mg/L	13 mg/L	
PGSP0483				262 mg/L	12 mg/L	
PGSP0484				284 mg/L	6 mg/L	
PGSP0485				270 mg/L	20 mg/L	
PGSP0486				268 mg/L	6 mg/L	
PGSP0487				240 mg/L	16 mg/L	
PGSP0488				256 mg/L	24 mg/L	
PGSP0491				272 mg/L	13 mg/L	
PGSP0492				276 mg/L	11 mg/L	
PGSP0493				280 mg/L	22 mg/L	
PGSP0497				210 mg/L	45 mg/L	
PGSP0498				218 mg/L	30 mg/L	
PGSP0499				222 mg/L	29 mg/L	
PGSP0500				216 mg/L	56 mg/L	
PGSP0501				406 mg/L	97 mg/L	
PGSP0502				228 mg/L	123 mg/L	
PGSP0503				236 mg/L	165 mg/L	
PGSP0504				234 mg/L	15 mg/L	
PGSP0505				250 mg/L	3 mg/L	
PGSP0506				264 mg/L	226 mg/L	
PGSP0507				254 mg/L	373 mg/L	
PGSP0508				178 mg/L	706 mg/L	
PGSP0509				134 mg/L	951 mg/L	
PGSP0510				132 mg/L	764 mg/L	
PGSP0511				130 mg/L	621 mg/L	
PGSP0512				142 mg/L	540 mg/L	
PGSP0513				150 mg/L	364 mg/L	
PGSP0514				142 mg/L	321 mg/L	
PGSP0515				146 mg/L	271 mg/L	
PGSP0516				150 mg/L	210 mg/L	
PGSP0517				164 mg/L	123 mg/L	
PGSP0518				178 mg/L	91 mg/L	

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
PGSP0519				176 mg/L	71 mg/L	
PGSP0520				200 mg/L	67 mg/L	
Average*	7.03 SU	430 µS		222 mg/L	179.32 mg/L	0.738 mg/L
Maximum	7.36 SU	508 µS		640 mg/L	2278.00 mg/L	2.360 mg/L
Minimum	6.75 SU	352 µS		20 mg/L	3.00 mg/L	0.006 mg/L
Standard Deviation	.29	87.5		57.7	326.43	.969
Coefficient Variation	.04	.2		.3	1.82	1.314
Total of 146 analyses for Pleasant Grove Spring						

Leslie Page karst window, October 1993–September 1994

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
LPKW0024	6.17 SU	171 µS		104 mg/L	34 mg/L	0.842 mg/L
LPKW0026				62 mg/L	4 mg/L	
LPKW0027				88 mg/L		
LPKW0028				58 mg/L		
LPKW0029				66 mg/L		
LPKW0030				60 mg/L		
LPKW0031				48 mg/L		
LPKW0032				74 mg/L	3 mg/L	
LPKW0033				46 mg/L		
LPKW0034				48 mg/L		
LPKW0035				50 mg/L		
LPKW0036				44 mg/L		
LPKW0037				100 mg/L	3 mg/L	
LPKW0038				32 mg/L		
LPKW0040				38 mg/L		
LPKW0041				108 mg/L	3 mg/L	
LPKW0042				34 mg/L		
LPKW0043				38 mg/L		
LPKW0044				32 mg/L		
LPKW0045				102 mg/L	3 mg/L	
LPKW0046				96 mg/L	3 mg/L	
LPKW0047				100 mg/L	3 mg/L	
LPKW0048				118 mg/L	3 mg/L	
LPKW0049				84 mg/L	3 mg/L	
LPKW0050				108 mg/L		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Leslie Page karst window, October 1993–September 1994 (Continued)

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
LPKW0053				66 mg/L		
LPKW0054				90 mg/L		
LPKW0055				96 mg/L		
LPKW0056				78 mg/L		
LPKW0057				88 mg/L		
LPKW0058				98 mg/L		
LPKW0059				102 mg/L		
LPKW0060				102 mg/L		
LPKW0061				114 mg/L		
LPKW0062				114 mg/L		
LPKW0063				108 mg/L		
LPKW0064				108 mg/L		
LPKW0065				118 mg/L		
LPKW0066				114 mg/L		
LPKW0067				120 mg/L		
LPKW0068				114 mg/L		
LPKW0069				56 mg/L		
LPKW0070				88 mg/L		
LPKW0071				102 mg/L		
LPKW0072				76 mg/L		
LPKW0073				108 mg/L		
LPKW0074				116 mg/L		
LPKW0075				116 mg/L		
LPKW0076				114 mg/L		
LPKW0078				126 mg/L		
Average*	6.17 SU	171 µS		85 mg/L	6.20 mg/L	0.842 mg/L
Maximum	6.17 SU	171 µS		126 mg/L	34.00 mg/L	0.842 mg/L
Minimum	6.17 SU	171 µS		32 mg/L	3.00 mg/L	0.842 mg/L
Standard Deviation				28.5	9.77	
Coefficient Variation				.3	1.58	
Total of 50 analyses for Leslie Page karst window						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Miller Schoolhouse water well, October 1993–September 1994

Sample Number	Laboratory pH	Laboratory Specific Conductance (25°C)	Total Alkalinity (mg/L as $CaCO_3$)	Dissolved Solids Residue on Evaporation (mg/L 180°C)	Suspended Solids Residue on Evaporation (mg/L 180°C)	Total Iron (mg/L as Fe)
MSHW0001	7.51 SU	590 µS		350 mg/L	8 mg/L	0.237 mg/L
Total of 1 analyses for Miller Schoolhouse water well						

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, October 1993–September 1994

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
PGSP0303	90.20 mg/L	9.22 mg/L	2.37 mg/L	1.21 mg/L	307 mg/L	5.76 mg/L	4.90 mg/L
PGSP0304	92.10 mg/L	9.52 mg/L	2.43 mg/L	1.25 mg/L	308 mg/L	6.24 mg/L	4.98 mg/L
PGSP0343	59.20 mg/L	5.19 mg/L	2.33 mg/L	1.76 mg/L	178 mg/L	6.30 mg/L	6.84 mg/L
PGSP0364	42.60 mg/L	4.26 mg/L	1.71 mg/L	2.65 mg/L	128 mg/L	5.80 mg/L	5.10 mg/L
PGSP0412	60.40 mg/L	5.56 mg/L	2.05 mg/L	1.30 mg/L	190 mg/L	5.10 mg/L	5.30 mg/L
Average*	68.90 mg/L	6.75 mg/L	2.18 mg/L	1.63 mg/L	222.20 mg/L	5.84 mg/L	5.42 mg/L
Maximum	92.10 mg/L	9.52 mg/L	2.43 mg/L	2.65 mg/L	308.00 mg/L	6.30 mg/L	6.84 mg/L
Minimum	42.60 mg/L	4.26 mg/L	1.71 mg/L	1.21 mg/L	128.00 mg/L	5.10 mg/L	4.90 mg/L
Standard Deviation	21.51	2.44	.30	.61	81.27	.48	.81
Coefficient Variation	.31	.36	.14	.37	.37	.08	.15
Number of analyses 5							

Leslie Page karst window, October 1993–September 1994

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
LPKW0024	23.90 mg/L	2.85 mg/L	2.45 mg/L	1.30 mg/L	63 mg/L	12.90 mg/L	8.32 mg/L
Number of analyses 1							

Miller Schoolhouse water well, October 1993–September 1994

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
MSHW0001	54.80 mg/L	32.00 mg/L	14.60 mg/L	1.21 mg/L	348 mg/L	26.20 mg/L	5.30 mg/L
Number of analyses 1							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

APPENDIX H:
Water Sample Analyses and Descriptive Statistics for Samples Collected from Pleasant Grove Spring and Shackelford Spring and Used to Develop Figure 10

Pleasant Grove Spring

Sample Number†	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
PGSP0003	68.20 mg/L	6.15 mg/L	2.21 mg/L	1.12 mg/L	212 mg/L	10.90 mg/L	5.86 mg/L
PGSP0004	65.60 mg/L	5.93 mg/L	2.11 mg/L	1.26 mg/L	195 mg/L	5.62 mg/L	5.18 mg/L
PGSP0006	76.60 mg/L	7.40 mg/L	2.18 mg/L	1.17 mg/L	244 mg/L	5.40 mg/L	5.28 mg/L
PGSP0007	88.00 mg/L	8.46 mg/L	2.26 mg/L	1.15 mg/L	273 mg/L	7.53 mg/L	4.65 mg/L
PGSP0008	85.90 mg/L	8.37 mg/L	2.17 mg/L	1.22 mg/L	283 mg/L	5.82 mg/L	4.33 mg/L
PGSP0009	88.90 mg/L	8.85 mg/L	2.24 mg/L	0.93 mg/L	290 mg/L	6.24 mg/L	4.13 mg/L
PGSP0010	76.90 mg/L	6.58 mg/L	2.46 mg/L	1.77 mg/L	201 mg/L	5.60 mg/L	5.83 mg/L
PGSP0011	76.30 mg/L	6.96 mg/L	2.33 mg/L	0.92 mg/L	232 mg/L	5.53 mg/L	10.30 mg/L
PGSP0012	79.00 mg/L	7.21 mg/L	2.48 mg/L	1.62 mg/L	239 mg/L	6.02 mg/L	6.22 mg/L
PGSP0013	70.70 mg/L	6.17 mg/L	2.40 mg/L	1.20 mg/L	213 mg/L	5.26 mg/L	6.41 mg/L
PGSP0021	78.90 mg/L	7.38 mg/L	2.37 mg/L	1.42 mg/L	239 mg/L	5.18 mg/L	4.87 mg/L
PGSP0026	79.90 mg/L	7.66 mg/L	2.32 mg/L	1.31 mg/L	245 mg/L	5.66 mg/L	5.26 mg/L
Average*	77.91 mg/L	7.26 mg/L	2.29 mg/L	1.26 mg/L	238.83 mg/L	6.23 mg/L	5.69 mg/L
Maximum	88.90 mg/L	8.85 mg/L	2.48 mg/L	1.77 mg/L	290.00 mg/L	10.90 mg/L	10.30 mg/L
Minimum	65.60 mg/L	5.93 mg/L	2.11 mg/L	0.92 mg/L	195.00 mg/L	5.18 mg/L	4.13 mg/L
Standard Deviation	7.36	.96	.12	.25	31.02	1.60	1.62
Coefficient Variation	.09	.13	.05	.20	.13	.26	.28
Number of analyses 12							

Shackelford Spring

Sample Number	Total Calcium (mg/L as Ca)	Total Magnesium (mg/L as Mg)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Total Sulfate (mg/L as SO_4)	Dissolved Chloride (mg/L as Cl)
SKSP0003	71.30 mg/L	5.54 mg/L	2.87 mg/L	1.10 mg/L	199 mg/L	10.60 mg/L	8.60 mg/L
SKSP0004	72.40 mg/L	5.65 mg/L	2.88 mg/L	0.93 mg/L	198 mg/L	7.11 mg/L	8.67 mg/L
SKSP0005	75.80 mg/L	5.81 mg/L	3.23 mg/L	1.05 mg/L	205 mg/L	6.04 mg/L	9.45 mg/L
SKSP0006	77.70 mg/L	5.99 mg/L	3.08 mg/L	1.07 mg/L	217 mg/L	12.60 mg/L	9.53 mg/L
SKSP0007	76.30 mg/L	6.00 mg/L	2.96 mg/L	1.18 mg/L	224 mg/L	8.76 mg/L	9.52 mg/L
SKSP0008	78.00 mg/L	6.02 mg/L	3.04 mg/L	0.93 mg/L	232 mg/L	7.40 mg/L	9.29 mg/L
SKSP0009	75.90 mg/L	5.90 mg/L	2.85 mg/L	1.39 mg/L	207 mg/L	6.80 mg/L	8.05 mg/L
SKSP0010	76.60 mg/L	5.85 mg/L	3.02 mg/L	1.18 mg/L	208 mg/L	6.44 mg/L	9.72 mg/L
SKSP0011	77.00 mg/L	5.90 mg/L	3.14 mg/L	1.35 mg/L	208 mg/L	7.47 mg/L	9.96 mg/L
SKSP0012	75.80 mg/L	5.85 mg/L	2.95 mg/L	1.20 mg/L	207 mg/L	6.47 mg/L	8.81 mg/L
SKSP0013	76.10 mg/L	5.81 mg/L	3.03 mg/L	1.15 mg/L	206 mg/L	6.33 mg/L	8.80 mg/L
SKSP0014	75.20 mg/L	5.84 mg/L	3.20 mg/L	1.04 mg/L	211 mg/L	7.32 mg/L	10.00 mg/L
Average*	75.68 mg/L	5.85 mg/L	3.02 mg/L	1.13 mg/L	210.17 mg/L	7.78 mg/L	9.20 mg/L
Maximum	78.00 mg/L	6.02 mg/L	3.23 mg/L	1.39 mg/L	232.00 mg/L	12.60 mg/L	10.00 mg/L
Minimum	71.30 mg/L	5.54 mg/L	2.85 mg/L	0.93 mg/L	198.00 mg/L	6.04 mg/L	8.05 mg/L
Standard Deviation	1.97	.14	.13	.14	9.82	1.97	.61
Coefficient Variation	.03	.02	.04	.13	.05	.25	.07
Number of analyses 12							

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

† See Appendix G for collection dates and additional data.

APPENDIX I:
Pesticide Analysis for Water Samples from the Pleasant Grove Spring Drainage Basin

Pleasant Grove Spring, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0003	May/01/1991	10:10		0.390 µg/L	<0.320 µg/L				<0.035 µg/L	0.031 µg/L
PGSP0004	May/22/1991	11:30		1.300 µg/L	<0.350 µg/L				<0.048 µg/L	0.170 µg/L
PGSP0005	Jun/26/1991	09:42		1.400 µg/L	<0.250 µg/L				0.087 µg/L	0.100 µg/L
PGSP0006	Jul/25/1991	10:15		0.470 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
PGSP0007	Aug/29/1991	12:30		0.340 µg/L	<0.250 µg/L				<0.036 µg/L	0.031 µg/L
PGSP0008	Sep/24/1991	09:30		0.230 µg/L	<0.250 µg/L				<0.036 µg/L	0.030 µg/L
			Average*	.688 µg/L	.278 µg/L				.046 µg/L	.064 µg/L
			Maximum	1.400 µg/L	.350 µg/L				.087 µg/L	.170 µg/L
			Minimum	.230 µg/L	.250 µg/L				.035 µg/L	.020 µg/L
			Standard Deviation	.519	.045				.021	.060
			Coefficient Variation	.755	.161				.443	.937
			Number of Analyses	6	6				6	6

Spring Valley karst window, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
SVKW0004	Jun/26/1991	11:00		1.400 µg/L	<0.250 µg/L				0.081 µg/L	0.090 µg/L
SVKW0006	Aug/29/1991	11:35		0.370 µg/L	<0.250 µg/L				<0.036 µg/L	0.020 µg/L
SVKW0007	Sep/24/1991	08:40		0.270 µg/L	<0.250 µg/L				<0.036 µg/L	0.027 µg/L
			Average*	.680 µg/L	.250 µg/L				.051 µg/L	.046 µg/L
			Maximum	1.400 µg/L	.250 µg/L				.081 µg/L	.090 µg/L
			Minimum	.270 µg/L	.250 µg/L				.036 µg/L	.020 µg/L
			Number of Analyses	3	3				3	3

The Canyon karst window, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
TCKW0002	May/01/1991	08:45		0.750 µg/L	<0.320 µg/L				<0.035 µg/L	<0.022 µg/L
TCKW0003	May/22/1991	09:30		1.000 µg/L	<0.350 µg/L				<0.048 µg/L	<0.022 µg/L
TCKW0004	Jun/26/1991	07:45		1.100 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
TCKW0005	Jul/25/1991	08:24		0.390 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
TCKW0006	Aug/29/1991	10:45		0.360 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
TCKW0007	Sep/24/1991	07:40		0.230 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
			Average*	.638 µg/L	.278 µg/L				.038 µg/L	.021 µg/L
			Maximum	1.100 µg/L	.350 µg/L				.048 µg/L	.022 µg/L
			Minimum	.230 µg/L	.250 µg/L				.035 µg/L	.020 µg/L
			Standard Deviation	.364	.045				.005	.001
			Coefficient Variation	.570	.160				.132	.050
			Number of Analyses	6	6				6	6

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Shackelford Spring, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
SKSP0003	May/01/1991	07:05		0.720 µg/L	<0.320 µg/L				<0.035 µg/L	<0.022 µg/L
SKSP0005	Jul/25/1991	07:20		0.530 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
SKSP0006	Aug/29/1991	10:00		0.380 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
SKSP0007	Sep/24/1991	06:40		0.310 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
			Average*	.485 µg/L	.268 µg/L				.036 µg/L	.021 µg/L
			Maximum	.720 µg/L	.320 µg/L				.036 µg/L	.022 µg/L
			Minimum	.310 µg/L	.250 µg/L				.035 µg/L	.020 µg/L
			Standard Deviation	.182	.035				.001	.001
			Coefficient Variation	.374	.131				.014	.049
			Number of Analyses	4	4				4	4

Thad Flowers bluehole, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
TFBH0002	May/01/1991	07:45		0.570 µg/L	<0.320 µg/L				<0.035 µg/L	0.025 µg/L
TFBH0003	May/22/1991	06:50		0.550 µg/L	<0.350 µg/L				<0.048 µg/L	<0.022 µg/L
TFBH0004	Jun/26/1991	07:15		0.590 µg/L	<0.250 µg/L				0.110 µg/L	0.180 µg/L
TFBH0005	Jul/25/1991	11:10		1.200 µg/L	0.570 µg/L				0.053 µg/L	<0.020 µg/L
TFBH0006	Aug/29/1991	09:25		<0.160 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
			Average*	.614 µg/L	.348 µg/L				.056 µg/L	.053 µg/L
			Maximum	1.200 µg/L	.570 µg/L				.110 µg/L	.180 µg/L
			Minimum	.160 µg/L	.250 µg/L				.035 µg/L	.020 µg/L
			Standard Deviation	.373	.132				.031	.071
			Coefficient Variation	.607	.378				.549	1.326
			Number of Analyses	5	5				5	5

George Delaney swallow hole, August 1990–September 1991

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
GDSW0001	May/22/1991	10:30		1.300 µg/L	<0.350 µg/L				<0.048 µg/L	0.039 µg/L
GDSW0002	Jun/26/1991	08:50		1.000 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
GDSW0003	Jul/25/1991	08:55		0.480 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
			Average*	.927 µg/L	.283 µg/L				.040 µg/L	.026 µg/L
			Maximum	1.300 µg/L	.350 µg/L				.048 µg/L	.039 µg/L
			Minimum	.480 µg/L	.250 µg/L				.036 µg/L	.020 µg/L
			Number of Analyses	3	3				3	3

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Pleasant Grove Spring, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0009	Oct/22/1991	08:50		0.280 µg/L	<0.250 µg/L				<0.036 µg/L	0.024 µg/L
PGSP0010	Dec/17/1991	08:06		0.100 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
PGSP0011	Jan/29/1992	11:00		0.290 µg/L	0.590 µg/L				<0.040 µg/L	<0.018 µg/L
PGSP0012	Feb/26/1992	12:15		0.250 µg/L	1.100 µg/L		<0.070 µg/L		<0.040 µg/L	<0.018 µg/L
PGSP0013	Mar/25/1992	13:20		0.450 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
PGSP0014	Apr/01/1992	16:16	0.610 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0015	Apr/09/1992	15:28	0.740 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0016	Apr/16/1992	10:30	0.630 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0017	Apr/20/1992	18:55	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0018	Apr/21/1992	08:30	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0019	Apr/21/1992	17:55	1.100 µg/L				0.130 µg/L	<0.060 µg/L		
PGSP0020	Apr/22/1992	07:37	0.770 µg/L				0.110 µg/L	0.094 µg/L		
PGSP0021	Apr/29/1992	09:40	0.570 µg/L	0.270 µg/L	<0.250 µg/L		<0.070 µg/L		0.250 µg/L	<0.018 µg/L
PGSP0022	May/07/1992	12:30	0.580 µg/L				0.100 µg/L		<0.060 µg/L	<0.060 µg/L
PGSP0023	May/14/1992	08:30	0.490 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0024	May/20/1992	07:35	4.000 µg/L				0.570 µg/L	1.800 µg/L		
PGSP0025	May/20/1992	14:30	5.600 µg/L				0.560 µg/L	1.200 µg/L		
PGSP0026	May/27/1992	10:45	1.400 µg/L	1.200 µg/L	<0.250 µg/L		<0.070 µg/L	0.081 µg/L	0.540 µg/L	0.018 µg/L
PGSP0027	Jun/03/1992	15:45	1.500 µg/L	0.940 µg/L	<0.250 µg/L		0.081 µg/L	<0.060 µg/L	0.380 µg/L	<0.018 µg/L
PGSP0028	Jun/04/1992	02:58	1.400 µg/L				0.077 µg/L	<0.060 µg/L		
PGSP0029	Jun/04/1992	03:18	1.200 µg/L				0.120 µg/L	<0.060 µg/L		
PGSP0030	Jun/04/1992	03:38	1.200 µg/L				0.160 µg/L	<0.060 µg/L		
PGSP0031	Jun/04/1992	03:58	1.200 µg/L				0.200 µg/L	<0.060 µg/L		
PGSP0032	Jun/04/1992	04:18	1.400 µg/L				0.120 µg/L	<0.060 µg/L		
PGSP0033	Jun/04/1992	04:38	2.200 µg/L				0.160 µg/L	1.100 µg/L		
PGSP0034	Jun/04/1992	04:58	2.800 µg/L				0.110 µg/L	2.300 µg/L		
PGSP0035	Jun/04/1992	05:18	2.300 µg/L				<0.070 µg/L	1.200 µg/L		
PGSP0036	Jun/04/1992	05:38	2.100 µg/L				<0.070 µg/L	0.600 µg/L		
PGSP0037	Jun/04/1992	05:58	2.600 µg/L				<0.070 µg/L	0.370 µg/L		
PGSP0038	Jun/04/1992	06:58	3.700 µg/L				0.210 µg/L	0.760 µg/L		
PGSP0039	Jun/04/1992	07:58	2.200 µg/L				0.280 µg/L	0.580 µg/L		
PGSP0040	Jun/04/1992	08:58	2.900 µg/L				0.390 µg/L	0.600 µg/L		
PGSP0041	Jun/04/1992	09:58	2.200 µg/L				0.470 µg/L	0.180 µg/L		
PGSP0042	Jun/04/1992	10:58	1.900 µg/L				1.000 µg/L	0.380 µg/L		
PGSP0043	Jun/04/1992	11:58	2.000 µg/L				1.600 µg/L	0.270 µg/L		
PGSP0044	Jun/04/1992	12:58	2.900 µg/L				1.100 µg/L	0.390 µg/L		
PGSP0045	Jun/04/1992	13:58	2.700 µg/L				0.300 µg/L	0.220 µg/L		
PGSP0046	Jun/04/1992	14:58	2.300 µg/L				0.340 µg/L	0.170 µg/L		
PGSP0047	Jun/04/1992	15:58	2.500 µg/L				0.200 µg/L	0.200 µg/L		
PGSP0052	Jun/04/1992	17:15	3.000 µg/L	2.600 µg/L	0.300 µg/L		0.310 µg/L	0.150 µg/L	0.520 µg/L	0.073 µg/L
PGSP0048	Jun/04/1992	19:58	3.400 µg/L				0.260 µg/L	0.300 µg/L		
PGSP0049	Jun/04/1992	23:58	4.000 µg/L				0.270 µg/L	0.350 µg/L		
PGSP0050	Jun/05/1992	03:58	4.200 µg/L				0.480 µg/L	0.440 µg/L		
PGSP0051	Jun/05/1992	07:58	3.000 µg/L				0.300 µg/L	0.350 µg/L		
PGSP0053	Jun/10/1992	13:20	1.100 µg/L				0.086 µg/L	<0.060 µg/L		
PGSP0054	Jun/18/1992	09:30	1.100 µg/L	1.000 µg/L	<0.250 µg/L		0.370 µg/L	<0.060 µg/L	0.330 µg/L	0.035 µg/L
PGSP0055	Jun/24/1992	13:35	0.870 µg/L				0.120 µg/L	<0.060 µg/L		
PGSP0056	Jul/01/1992	15:00	0.880 µg/L				<0.070 µg/L	<0.060 µg/L		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Pleasant Grove Spring, October 1991–September 1992 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0057	Jul/08/1992	11:15	0.880 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0058	Jul/13/1992	15:00	0.990 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0059	Jul/23/1992	15:45	0.820 µg/L				<0.070 µg/L	0.081 µg/L		
PGSP0060	Jul/30/1992	06:55	0.810 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0061	Aug/13/1992	14:15	0.760 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0062	Aug/26/1992	11:30	0.550 µg/L	0.370 µg/L	<0.083 µg/L	<0.100 µg/L	<0.070 µg/L	<0.060 µg/L	<0.040 µg/L	<0.018 µg/L
PGSP0063	Sep/09/1992	11:42	0.570 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0064	Sep/23/1992	14:25	0.610 µg/L				<0.070 µg/L	0.200 µg/L		
		Average*	1.772 µg/L	.705 µg/L	.348 µg/L	.100 µg/L	.232 µg/L	.321 µg/L	.193 µg/L	.028 µg/L
		Maximum	5.600 µg/L	2.600 µg/L	1.100 µg/L	.100 µg/L	1.600 µg/L	2.300 µg/L	.540 µg/L	.073 µg/L
		Minimum	.490 µg/L	.100 µg/L	.083 µg/L	.100 µg/L	.070 µg/L	.060 µg/L	.036 µg/L	.018 µg/L
		Standard Deviation	1.199	.726	.276		.292	.469	.201	.019
		Coefficient Variation	.677	1.030	.795		1.261	1.459	1.041	.674
		Number of Analyses	51	11	11	1	52	49	12	12

Spring Valley karst window, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
SVKW0008	Oct/22/1991	08:00		0.280 µg/L	<0.250 µg/L				<0.036 µg/L	0.021 µg/L
SVKW0009	Jan/29/1992	10:00		<0.210 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
SVKW0010	Feb/26/1992	11:00		0.360 µg/L	4.500 µg/L		<0.070 µg/L		<0.040 µg/L	<0.018 µg/L
SVKW0011	Mar/25/1992	10:55		0.320 µg/L	<0.250 µg/L				<0.040 µg/L	0.041 µg/L
SVKW0012	Apr/01/1992	15:15	0.880 µg/L				<0.070 µg/L	<0.060 µg/L		
SVKW0013	Apr/29/1992	08:40	0.590 µg/L	0.250 µg/L	<0.250 µg/L		<0.070 µg/L	<0.060 µg/L	0.110 µg/L	<0.018 µg/L
SVKW0014	May/27/1992	09:15	1.400 µg/L	1.200 µg/L	<0.250 µg/L		<0.070 µg/L	0.070 µg/L	0.400 µg/L	<0.018 µg/L
		Average*	.957 µg/L	.437 µg/L	.958 µg/L		.070 µg/L	.063 µg/L	.111 µg/L	.022 µg/L
		Maximum	1.400 µg/L	1.200 µg/L	4.500 µg/L		.070 µg/L	.070 µg/L	.400 µg/L	.041 µg/L
		Minimum	.590 µg/L	.210 µg/L	.250 µg/L		.070 µg/L	.060 µg/L	.036 µg/L	.018 µg/L
		Standard Deviation	.410	.378	1.735			.006	.144	.009
		Coefficient Variation	.429	.865	1.810			.091	1.301	.413
		Number of Analyses	3	6	6		4	3	6	6

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

The Canyon karst window, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
TCKW0008	Dec/17/1991	11:30		0.300 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
TCKW0009	Jan/29/1992	08:30		0.310 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
TCKW0010	Feb/26/1992	09:45		0.280 µg/L	2.200 µg/L		<0.070 µg/L		<0.040 µg/L	<0.018 µg/L
TCKW0011	Mar/25/1992	12:00		0.440 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
TCKW0012	Apr/01/1992	14:45	0.960 µg/L				<0.070 µg/L		<0.060 µg/L	
TCKW0013	Apr/29/1992	07:40	0.650 µg/L	<0.340 µg/L	<0.250 µg/L		<0.070 µg/L		0.220 µg/L	<0.018 µg/L
TCKW0014	May/27/1992	10:05	1.100 µg/L	0.930 µg/L	<0.250 µg/L		<0.070 µg/L	0.110 µg/L	0.410 µg/L	<0.018 µg/L
		Average*	.903 µg/L	.433 µg/L	.575 µg/L		.070 µg/L	.110 µg/L	.121 µg/L	.018 µg/L
		Maximum	1.100 µg/L	.930 µg/L	2.200 µg/L		.070 µg/L	.110 µg/L	.410 µg/L	.018 µg/L
		Minimum	.650 µg/L	.280 µg/L	.250 µg/L		.070 µg/L	.110 µg/L	.040 µg/L	.018 µg/L
		Standard Deviation	.230	.250	.796				.143	
		Coefficient Variation	.255	.576	1.384				1.180	
		Number of Analyses	3	6	6		4	1	7	6

Shackelford Spring, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
SKSP0008	Oct/22/1991	06:34		0.290 µg/L	<0.250 µg/L				<0.036 µg/L	<0.020 µg/L
SKSP0009	Dec/17/1991	12:00		0.480 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
SKSP0010	Jan/28/1992	14:30		0.300 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
SKSP0011	Feb/26/1992	08:40		0.310 µg/L	<0.250 µg/L		<0.070 µg/L		<0.040 µg/L	<0.018 µg/L
SKSP0012	Mar/25/1992	08:40		<0.210 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
SKSP0013	Apr/29/1992	06:43	0.510 µg/L	0.250 µg/L	<0.250 µg/L		<0.070 µg/L		<0.040 µg/L	<0.018 µg/L
SKSP0014	May/27/1992	11:50	1.100 µg/L	0.830 µg/L	<0.250 µg/L		<0.070 µg/L	<0.060 µg/L	0.120 µg/L	<0.018 µg/L
		Average*	.805 µg/L	.381 µg/L	.250 µg/L		.070 µg/L	.060 µg/L	.051 µg/L	.018 µg/L
		Maximum	1.100 µg/L	.830 µg/L	.250 µg/L		.070 µg/L	.060 µg/L	.120 µg/L	.020 µg/L
		Minimum	.510 µg/L	.210 µg/L	.250 µg/L		.070 µg/L	.060 µg/L	.036 µg/L	.018 µg/L
		Standard Deviation	.417	.215					.031	.001
		Coefficient Variation	.518	.564					.600	.041
		Number of Analyses	2	7	7		3	1	7	7

Thad Flowers bluehole, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
TFBH0007	Dec/17/1991	13:30		0.300 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
TFBH0008	Jan/28/1992	07:50		<0.210 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
TFBH0009	Feb/26/1992	07:30		0.560 µg/L	<0.250 µg/L		0.090 µg/L		<0.040 µg/L	<0.018 µg/L
TFBH0010	Mar/25/1992	07:20		0.260 µg/L	<0.250 µg/L				<0.040 µg/L	<0.018 µg/L
		Average*		.333 µg/L	.250 µg/L		.090 µg/L		.040 µg/L	.018 µg/L
		Maximum		.560 µg/L	.250 µg/L		.090 µg/L		.040 µg/L	.018 µg/L
		Minimum		.210 µg/L	.250 µg/L		.090 µg/L		.040 µg/L	.018 µg/L
		Standard Deviation		.156						
		Coefficient Variation		.469						
		Number of Analyses		4	4		1		4	4

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

George Delaney swallow hole, October 1991–September 1992

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
GDSW0004	Dec/17/1991	10:00		0.230 µg/L	<0.250 µg/L				<0.040 µg/L	0.071 µg/L
GDSW0005	Jan/29/1992	09:10		<0.210 µg/L	0.420 µg/L				<0.040 µg/L	<0.018 µg/L
GDSW0006	Feb/26/1992	10:20		0.460 µg/L	1.000 µg/L		<0.0700ug/L		<0.040 µg/L	<0.018 µg/L
GDSW0007	Mar/25/1992	09:45		<0.210 µg/L	<0.250 µg/L				<0.040 µg/L	0.043 µg/L
GDSW0008	Apr/01/1992	15:45	0.480 µg/L				<0.0700ug/L	<0.060		
		Average*		.278 µg/L	.480 µg/L		.0700 µg/L		.040 µg/L	.038 µg/L
		Maximum		.460 µg/L	1.000 µg/L		.0700 µg/L		.040 µg/L	.071 µg/L
		Minimum		.210 µg/L	.250 µg/L		.0700 µg/L		.040 µg/L	.018 µg/L
		Standard Deviation		.122	.356					.025
		Coefficient Variation		.440	.741					.673
		Number of Analyses	1	4	4		2	1	4	4

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Pleasant Grove Spring, October 1992–September 1993

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0065	Oct/06/1992	12:50	0.760 µg/L		<0.160 µg/L	<0.150 µg/L	<0.070 µg/L	<0.060 µg/L	<0.035 µg/L	<0.018 µg/L
PGSP0066	Oct/22/1992	10:14	0.410 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0067	Nov/06/1992	09:00	0.530 µg/L	0.270 µg/L	<0.160 µg/L	<0.150 µg/L	<0.070 µg/L	<0.060 µg/L	<0.035 µg/L	<0.018 µg/L
PGSP0068	Nov/20/1992	11:54	0.620 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0070	Dec/03/1992	09:07	0.760 µg/L	0.330 µg/L	<0.160 µg/L	<0.150 µg/L	<0.070 µg/L	<0.060 µg/L	<0.035 µg/L	<0.018 µg/L
PGSP0071	Jan/08/1993	10:19	0.740 µg/L	0.340 µg/L	<0.160 µg/L	<0.200 µg/L	<0.070 µg/L	<0.060 µg/L	<0.035 µg/L	<0.018 µg/L
PGSP0072	Jan/13/1993	08:00	0.590 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0073	Jan/13/1993	09:00	0.570 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0074	Jan/13/1993	10:00	0.620 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0075	Jan/13/1993	11:00	0.660 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0076	Jan/13/1993	12:00	0.620 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0077	Jan/13/1993	13:00	0.640 µg/L				<0.070 µg/L	0.730 µg/L		
PGSP0078	Jan/13/1993	14:00	0.620 µg/L				<0.070 µg/L	<0.060 µg/L		<0.060 µg/L
PGSP0079	Jan/13/1993	15:00	0.590 µg/L				<0.070 µg/L	0.066 µg/L		
PGSP0080	Jan/13/1993	16:00	0.540 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0081	Jan/13/1993	17:00	0.630 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0082	Jan/21/1993	10:15	0.520 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0083	Jan/28/1993	15:06	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0084	Jan/28/1993	15:40	0.620 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0089	Jan/28/1993	20:40	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0095	Jan/29/1993	02:40	0.640 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0101	Jan/29/1993	08:40	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0107	Jan/29/1993	14:40	0.670 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0108	Feb/04/1993	10:00	0.060 µg/L	0.290 µg/L	<0.160 µg/L	<0.200 µg/L	<0.070 µg/L	<0.060 µg/L	<0.035 µg/L	<0.018 µg/L
PGSP0109	Feb/16/1993	06:10	0.640 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0110	Feb/16/1993	06:30	0.630 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0111	Feb/16/1993	06:50	0.700 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0112	Feb/16/1993	07:10	0.650 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0113	Feb/16/1993	07:30	0.740 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0114	Feb/16/1993	07:50	0.640 µg/L				<0.070 µg/L	0.062 µg/L		
PGSP0115	Feb/16/1993	08:10	0.730 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0116	Feb/16/1993	08:30	0.790 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0117	Feb/16/1993	08:50	0.670 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0118	Feb/16/1993	09:10	0.670 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0119	Feb/16/1993	10:10	0.670 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0120	Feb/16/1993	11:10	0.720 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0121	Feb/16/1993	12:10	0.720 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0122	Feb/16/1993	13:10	0.720 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0123	Feb/16/1993	14:10	0.740 µg/L				<0.070 µg/L	0.074 µg/L		

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Pleasant Grove Spring, October 1992–September 1993 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0124	Feb/16/1993	15:10	0.720 µg/L				<0.070 µg/L	0.065 µg/L		
PGSP0125	Feb/16/1993	16:10	0.760 µg/L	0.290 µg/L	<0.160 µg/L	<0.200 µg/L	<0.070 µg/L	0.066 µg/L	<0.035 µg/L	
PGSP0126	Feb/16/1993	17:10	0.750 µg/L				<0.070 µg/L	0.083 µg/L		
PGSP0127	Feb/16/1993	18:10	0.690 µg/L				<0.070 µg/L	0.060 µg/L		
PGSP0128	Feb/16/1993	19:10	0.720 µg/L				<0.070 µg/L	0.060 µg/L		
PGSP0129	Feb/16/1993	23:10	0.680 µg/L				<0.070 µg/L	0.062 µg/L		
PGSP0130	Feb/17/1993	03:10	0.660 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0131	Feb/17/1993	07:10	0.700 µg/L				<0.070 µg/L	0.066 µg/L		
PGSP0132	Feb/17/1993	11:10	0.710 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0133	Feb/17/1993	16:30	0.790 µg/L				<0.070 µg/L	0.061 µg/L		
PGSP0134	Feb/18/1993	08:00	0.830 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0135	Feb/21/1993	10:13	0.540 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0136	Feb/21/1993	10:33	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0137	Feb/21/1993	10:53	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0138	Feb/21/1993	11:13	0.540 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0139	Feb/21/1993	11:33	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0140	Feb/21/1993	11:53	0.590 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0141	Feb/21/1993	12:13	0.530 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0142	Feb/21/1993	12:33	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0143	Feb/21/1993	12:53	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0144	Feb/21/1993	13:13	0.590 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0145	Feb/21/1993	14:13	0.570 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0146	Feb/21/1993	15:13	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0147	Feb/21/1993	16:13	0.550 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0148	Feb/21/1993	17:13	0.550 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0149	Feb/21/1993	18:13	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0150	Feb/21/1993	19:13	0.490 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0151	Feb/21/1993	20:13	0.520 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0152	Feb/21/1993	21:13	0.510 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0153	Feb/21/1993	22:13	0.530 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0154	Feb/21/1993	23:13	0.690 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0155	Feb/22/1993	03:13	0.550 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0156	Feb/22/1993	07:13	0.510 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0157	Feb/22/1993	11:13	0.560 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0158	Feb/22/1993	15:13	0.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0159	Mar/03/1993	09:00	0.550 µg/L	0.260 µg/L	<0.360 µg/L	<0.240 µg/L	<0.070 µg/L	<0.060 µg/L	<0.031 µg/L	<0.018 µg/L
PGSP0160	Mar/18/1993	10:20	0.510 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0161	Mar/22/1993	20:15	0.590 µg/L				<0.070 µg/L	<0.060 µg/L		

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Pleasant Grove Spring, October 1992–September 1993 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0172	Mar/23/1993	01:15	0.580 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0176	Mar/23/1993	05:15	0.600 µg/L				<0.070 µg/L	0.069 µg/L		
PGSP0180	Mar/23/1993	09:15	0.630 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0181	Mar/23/1993	13:15	0.560 µg/L				<0.070 µg/L	0.075 µg/L		
PGSP0182	Mar/23/1993	17:15	0.440 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0183	Mar/23/1993	21:15	1.800 µg/L				<0.070 µg/L	0.067 µg/L		
PGSP0184	Mar/24/1993	01:15	2.600 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0185	Mar/25/1993	11:00	1.200 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0186	Mar/26/1993	02:28	0.980 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0187	Mar/26/1993	02:48	0.940 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0188	Mar/26/1993	03:08	0.900 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0189	Mar/26/1993	03:28	1.000 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0190	Mar/26/1993	03:48	0.880 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0191	Mar/26/1993	04:08	1.000 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0192	Mar/26/1993	04:28	0.810 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0193	Mar/26/1993	04:48	0.970 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0194	Mar/26/1993	05:08	0.850 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0195	Mar/26/1993	05:28	1.000 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0196	Mar/26/1993	06:28	0.860 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0197	Mar/26/1993	07:28	0.820 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0198	Mar/26/1993	08:28	0.900 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0199	Mar/26/1993	09:28	0.820 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0200	Mar/26/1993	10:28	0.770 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0201	Mar/26/1993	11:28	0.760 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0202	Mar/26/1993	12:28	0.790 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0203	Mar/26/1993	13:28	0.840 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0204	Mar/26/1993	14:28	0.810 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0205	Mar/26/1993	15:28	0.870 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0206	Mar/26/1993	19:28	1.100 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0207	Mar/26/1993	23:28	1.200 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0208	Mar/27/1993	03:28	1.200 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0209	Mar/27/1993	07:28	1.100 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0210	Apr/01/1993	16:54	0.900 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0211	Apr/07/1993	08:22	0.530 µg/L	0.430 µg/L	<0.360 µg/L	<0.240 µg/L	<0.070 µg/L	<0.060 µg/L	<0.031 µg/L	<0.018 µg/L
PGSP0212	Apr/21/1993	15:10	1.100 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0213	May/03/1993	17:39	1.200 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0214	May/03/1993	18:39	30.000 µg/L				<0.070 µg/L	9.300 µg/L		
PGSP0215	May/04/1993	13:55	41.000 µg/L	28.000 µg/L	<0.260 µg/L	4.400 µg/L	0.740 µg/L	8.200 µg/L	5.100 µg/L	6.100 µg/L

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Pleasant Grove Spring, October 1992–September 1993 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0216	May/04/1993	14:50	44.000 µg/L				0.830 µg/L	9.600 µg/L		
PGSP0217	May/04/1993	15:50	42.000 µg/L				0.870 µg/L	9.300 µg/L		
PGSP0218	May/04/1993	16:50	39.000 µg/L				0.950 µg/L	8.100 µg/L		
PGSP0219	May/04/1993	17:50	42.000 µg/L				0.900 µg/L	7.800 µg/L		
PGSP0220	May/04/1993	18:50	39.000 µg/L				0.890 µg/L	7.900 µg/L		
PGSP0221	May/04/1993	19:50	38.000 µg/L				0.760 µg/L	7.400 µg/L		
PGSP0222	May/04/1993	20:50	38.000 µg/L				0.700 µg/L	7.800 µg/L		
PGSP0223	May/04/1993	21:50	40.000 µg/L				0.790 µg/L	7.100 µg/L		
PGSP0224	May/04/1993	22:50	43.000 µg/L				0.710 µg/L	6.900 µg/L		
PGSP0225	May/05/1993	01:50	40.000 µg/L				0.640 µg/L	7.200 µg/L		
PGSP0226	May/05/1993	04:50	29.000 µg/L				0.500 µg/L	7.100 µg/L		
PGSP0227	May/05/1993	07:50	30.000 µg/L				0.430 µg/L	5.900 µg/L		
PGSP0228	May/05/1993	10:50	30.000 µg/L				0.430 µg/L	5.900 µg/L		
PGSP0229	May/05/1993	13:50	28.000 µg/L				0.400 µg/L	5.000 µg/L		
PGSP0230	May/05/1993	16:50	28.000 µg/L				0.350 µg/L	4.600 µg/L		
PGSP0231	May/05/1993	19:50	27.000 µg/L				0.340 µg/L	4.500 µg/L		
PGSP0232	May/05/1993	22:50	24.000 µg/L				0.300 µg/L	4.300 µg/L		
PGSP0233	May/06/1993	01:50	24.000 µg/L				0.300 µg/L	3.300 µg/L		
PGSP0234	May/06/1993	09:15	23.000 µg/L				0.240 µg/L	2.600 µg/L		
PGSP0235	May/18/1993	03:22	3.300 µg/L				<0.070 µg/L	0.910 µg/L		
PGSP0241	May/18/1993	09:22	3.000 µg/L				<0.070 µg/L	0.690 µg/L		
PGSP0251	May/19/1993	09:22	2.800 µg/L				<0.070 µg/L	0.730 µg/L		
PGSP0255	May/20/1993	09:42	2.800 µg/L				<0.070 µg/L	0.770 µg/L		
PGSP0256	May/21/1993	02:15	2.400 µg/L				<0.070 µg/L	0.320 µg/L		
PGSP0257	May/22/1993	02:15	2.300 µg/L				<0.070 µg/L	0.280 µg/L		
PGSP0258	May/23/1993	02:15	2.400 µg/L				<0.070 µg/L	0.250 µg/L		
PGSP0259	May/24/1993	02:15	1.900 µg/L				<0.070 µg/L	0.260 µg/L		
PGSP0260	May/26/1993	12:42	2.100 µg/L				<0.070 µg/L	0.200 µg/L		
PGSP0261	May/29/1993	18:50	2.000 µg/L				<0.070 µg/L	0.160 µg/L		
PGSP0262	Jun/01/1993	16:29	3.600 µg/L				0.660 µg/L	1.000 µg/L		
PGSP0263	Jun/02/1993	04:29	3.600 µg/L				0.600 µg/L	0.780 µg/L		
PGSP0264	Jun/02/1993	14:30	3.400 µg/L	2.300 µg/L	<0.260 µg/L		0.550 µg/L	0.700 µg/L	0.370 µg/L	0.080 µg/L
PGSP0265	Jun/08/1993	17:14	2.000 µg/L				0.100 µg/L	0.260 µg/L		
PGSP0266	Jun/16/1993	06:05	2.000 µg/L				<0.070 µg/L	0.130 µg/L		
PGSP0267	Jun/24/1993	09:23	1.600 µg/L				<0.070 µg/L	0.080 µg/L		
PGSP0268	Jun/24/1993	19:52	1.900 µg/L				<0.070 µg/L	0.180 µg/L		
PGSP0269	Jun/24/1993	20:52	2.100 µg/L				<0.070 µg/L	<0.060 µg/L		
PGSP0270	Jun/24/1993	21:52	1.700 µg/L				<0.070 µg/L	0.061 µg/L		

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Pleasant Grove Spring, October 1992–September 1993 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0271	Jun/24/1993	22:52	1.500 µg/L				<0.070 µg/L	0.130 µg/L		
PGSP0272	Jun/24/1993	23:52	1.800 µg/L				<0.070 µg/L	0.160 µg/L		
PGSP0273	Jun/25/1993	00:52	1.800 µg/L				<0.070 µg/L	0.150 µg/L		
PGSP0274	Jun/25/1993	01:52	1.700 µg/L				<0.070 µg/L	0.110 µg/L		
PGSP0275	Jun/25/1993	02:52	1.900 µg/L				<0.070 µg/L	0.180 µg/L		
PGSP0276	Jun/25/1993	03:52	1.800 µg/L				<0.070 µg/L	0.210 µg/L		
PGSP0277	Jun/25/1993	04:52	1.800 µg/L				<0.070 µg/L	0.110 µg/L		
PGSP0278	Jun/25/1993	07:52	1.400 µg/L				<0.070 µg/L	0.110 µg/L		
PGSP0279	Jun/25/1993	10:52	1.500 µg/L				<0.070 µg/L	0.140 µg/L		
PGSP0280	Jun/25/1993	13:52	1.600 µg/L				<0.070 µg/L	0.150 µg/L		
PGSP0281	Jun/25/1993	16:52	1.600 µg/L				<0.070 µg/L	0.089 µg/L		
PGSP0282	Jun/25/1993	19:52	1.400 µg/L				<0.070 µg/L	0.170 µg/L		
PGSP0283	Jun/25/1993	22:52	1.500 µg/L				<0.070 µg/L	0.120 µg/L		
PGSP0284	Jun/26/1993	01:52	1.400 µg/L				<0.070 µg/L	0.430 µg/L		
PGSP0285	Jun/26/1993	04:52	1.600 µg/L				<0.070 µg/L	1.300 µg/L		
PGSP0286	Jun/26/1993	07:52	0.820 µg/L				<0.070 µg/L	1.300 µg/L		
PGSP0287	Jun/26/1993	10:52	1.800 µg/L				0.083 µg/L	1.200 µg/L		
PGSP0288	Jun/26/1993	22:52	1.900 µg/L				0.077 µg/L	0.840 µg/L		
PGSP0289	Jun/27/1993	10:52	1.800 µg/L				<0.070 µg/L	0.320 µg/L		
PGSP0290	Jun/27/1993	22:52	0.960 µg/L				<0.070 µg/L	0.180 µg/L		
PGSP0291	Jun/28/1993	10:52	1.500 µg/L				<0.070 µg/L	0.130 µg/L		
PGSP0292	Jun/29/1993	11:00	1.800 µg/L	0.910 µg/L	<0.260 µg/L	<0.240 µg/L	<0.070 µg/L	0.160 µg/L	0.088 µg/L	<0.018 µg/L
PGSP0293	Jul/02/1993	16:04	1.500 µg/L				<0.070 µg/L	0.180 µg/L		
PGSP0294	Jul/03/1993	13:04	1.400 µg/L				<0.070 µg/L	0.100 µg/L		
PGSP0295	Jul/15/1993	12:08	1.200 µg/L				<0.070 µg/L	0.060 µg/L		
PGSP0296	Jul/16/1993	11:29	1.400 µg/L				<0.070 µg/L	0.670 µg/L		
PGSP0297	Jul/22/1993	11:17	1.200 µg/L				<0.070 µg/L	0.660 µg/L		
PGSP0298	Jul/29/1993	09:46	1.300 µg/L				<0.070 µg/L	0.060 µg/L		
PGSP0299	Aug/04/1993	09:00	1.100 µg/L	0.660 µg/L	<0.260 µg/L	<0.240 µg/L	<0.070 µg/L	0.067 µg/L	0.081 µg/L	<0.018 µg/L
PGSP0300	Aug/14/1993	15:53	1.000 µg/L					<0.060 µg/L		
PGSP0301	Aug/24/1993	12:18	0.970 µg/L				<0.070 µg/L	0.060 µg/L		
PGSP0302	Sep/09/1993	07:30	0.800 µg/L	0.400 µg/L	<0.260 µg/L		<0.070 µg/L	<0.060 µg/L	0.033 µg/L	<0.018 µg/L
		Average*	4.837 µg/L	2.873 µg/L	.231 µg/L	.583 µg/L	.137 µg/L	.891 µg/L	.457 µg/L	.459 µg/L
		Maximum	44.000 µg/L	28.000 µg/L	.360 µg/L	4.400 µg/L	.950 µg/L	9.600 µg/L	5.100 µg/L	6.100 µg/L
		Minimum	.060 µg/L	.260 µg/L	.160 µg/L	.150 µg/L	.070 µg/L	.060 µg/L	.031 µg/L	.018 µg/L
		Standard Deviation	10.829	7.934	.073	1.267	.193	2.181	1.398	1.624
		Coefficient Variation	2.239	2.761	.314	2.174	1.408	2.448	3.058	3.541
		Number of Analyses	184	11	13	10	183	184	12	14

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Spring Valley karst window, October 1992–September 1993

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
SVKW0015	May/20/1993	09:20	2.800 µg/L				<0.070 µg/L	0.840 µg/L		
SVKW0016	May/26/1993	12:10	2.000 µg/L				<0.070 µg/L	0.180 µg/L		
SVKW0017	Jun/02/1993	12:55	2.900 µg/L				0.540 µg/L	0.650 µg/L		
		Average*	2.567 µg/L				.227 µg/L	.557 µg/L		
		Maximum	2.900 µg/L				.540 µg/L	.840 µg/L		
		Minimum	2.000 µg/L				.070 µg/L	.180 µg/L		
		Standard Deviation	.493				.271	.340		
		Coefficient Variation	.192				1.197	.610		
		Number of Analyses	3				3	3		

George Delaney swallow hole, October 1992–September 1993

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
GDSW0009	May/20/1993	08:14	2.600 µg/L				<0.070 µg/L	1.000 µg/L		
GDSW0010	May/26/1993	11:50	1.900 µg/L				<0.070 µg/L	<0.060 µg/L		
GDSW010A	Jun/03/1993	08:45	3.100 µg/L					0.390 µg/L		
GDSW0011	Jun/17/1993	08:20	2.100 µg/L				<0.070 µg/L	<0.060 µg/L		
		Average*	2.425 µg/L				.070 µg/L	.378 µg/L		
		Maximum	3.100 µg/L				.070 µg/L	1.000 µg/L		
		Minimum	1.900 µg/L				.070 µg/L	.060 µg/L		
		Standard Deviation	.538					.443		
		Coefficient Variation	.222					1.174		
		Number of Analyses	4				3	4		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Leslie Page karst window, October 1992–September 1993

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
LPKW0001	Apr/10/1993	18:00	0.250 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0002	Apr/11/1993	06:00	0.360 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0003	Apr/11/1993	18:00	0.250 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0004	Apr/12/1993	06:00	0.340 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0005	Apr/12/1993	18:00	0.290 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0006	Apr/13/1993	06:00	0.340 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0007	May/05/1993	08:17	2.000 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0009	May/20/1993	11:10	1.100 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0010	May/26/1993	11:30	0.400 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW010A	Jun/02/1993	16:50	0.640 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0011	Jun/08/1993	08:34	0.450 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0012	Jun/17/1993	09:50	0.370 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0013	Jun/24/1993	10:00	0.440 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0014	Jun/30/1993	09:45	0.470 µg/L				<0.070 µg/L	0.082 µg/L		
LPKW0015	Jul/15/1993	11:22	0.280 µg/L				<0.070 µg/L	<0.060 µg/L		
LPKW0016	Jul/22/1993	10:19	0.300 µg/L				<0.070 µg/L	0.490 µg/L		
LPKW0017	Jul/29/1993	10:32	0.410 µg/L				<0.070 µg/L	<0.060 µg/L		
		Average*	.511 µg/L				.070 µg/L	.087 µg/L		
		Maximum	2.000 µg/L				.070 µg/L	.490 µg/L		
		Minimum	.250 µg/L				.070 µg/L	.060 µg/L		
		Standard Deviation	.433					.104		
		Coefficient Variation	.847					1.202		
		Number of Analyses	17				17	17		

Upper Pleasant Grove Creek, October 1992–September 1993

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
UPGC0001	Jun/17/1993	07:25	2.100 µg/L				<0.070 µg/L	0.370 µg/L		
UPGC0002	Jun/30/1993	09:10	2.200 µg/L				0.086 µg/L	0.470 µg/L		
UPGC0003	Aug/03/1993	15:33	1.700 µg/L				<0.070 µg/L	0.075 µg/L		
		Average*	2.000 µg/L				.075 µg/L	.305 µg/L		
		Maximum	2.200 µg/L				.086 µg/L	.470 µg/L		
		Minimum	1.700 µg/L				.070 µg/L	.075 µg/L		
		Standard Deviation	.265				.009	.205		
		Coefficient Variation	.132				.123	.673		
		Number of Analyses	3				3	3		

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Pleasant Grove Spring, October 1993–September 1994

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0303	Oct/06/1993	07:30	0.630µg/L	0.420µg/L	<0.260µg/L		<0.070µg/L	<0.060µg/L	0.031µg/L	<0.018µg/L
PGSP0304	Nov/09/1993	10:45	0.630µg/L	0.420µg/L	<0.260µg/L		<0.060µg/L	<0.031µg/L	<0.018µg/L	
PGSP0305	Nov/18/1993	12:37	0.510µg/L				<0.070µg/L	0.080µg/L		
PGSP0306	Dec/08/1993	09:30	1.500µg/L				<0.070µg/L	<0.060µg/L		
PGSP0307	Dec/09/1993	21:04	1.100µg/L				<0.070µg/L	<0.060µg/L		0.067µg/L
PGSP0308	Dec/09/1993	22:04	1.000µg/L							
PGSP0309	Dec/09/1993	23:04	1.100µg/L							
PGSP0310	Dec/10/1993	00:04	1.200µg/L							
PGSP0311	Dec/10/1993	01:04	1.000µg/L							
PGSP0312	Dec/10/1993	02:04	0.990µg/L				<0.070µg/L	<0.060µg/L		
PGSP0313	Dec/10/1993	03:04	1.200µg/L							
PGSP0314	Dec/10/1993	04:04	1.100µg/L							
PGSP0315	Dec/10/1993	05:04	1.000µg/L							
PGSP0316	Dec/10/1993	06:04	1.300µg/L							
PGSP0317	Dec/10/1993	09:04	0.870µg/L				<0.070µg/L	0.064µg/L		
PGSP0318	Dec/10/1993	12:04	0.680µg/L							
PGSP0319	Dec/10/1993	15:04	0.940µg/L							
PGSP0320	Dec/10/1993	18:04	0.850µg/L							
PGSP0321	Dec/10/1993	21:04	0.980µg/L							
PGSP0322	Dec/11/1993	00:04	1.100µg/L							
PGSP0323	Dec/11/1993	03:04	1.000µg/L							
PGSP0324	Dec/11/1993	06:04	1.100µg/L							
PGSP0325	Dec/11/1993	09:04	1.200µg/L							
PGSP0326	Dec/11/1993	12:04	1.000µg/L				<0.070µg/L	<0.060µg/L		
PGSP0327	Dec/12/1993	00:04	1.200µg/L							
PGSP0328	Dec/12/1993	12:04	1.000µg/L				<0.070µg/L	<0.060µg/L		
PGSP0329	Dec/13/1993	00:04	1.400µg/L							
PGSP0330	Dec/13/1993	12:04	0.880µg/L				<0.070µg/L	<0.060µg/L		
PGSP0332	Dec/29/1993	12:55	0.870µg/L				<0.080µg/L	<0.080µg/L		
PGSP0333	Jan/02/1994	03:55	0.830µg/L				<0.080µg/L	<0.080µg/L		
PGSP0334	Jan/12/1994	11:40	0.940µg/L				<0.080µg/L	<0.080µg/L		
PGSP0335	Jan/24/1994	17:24	0.570µg/L				<0.080µg/L	<0.080µg/L		
PGSP0336	Jan/24/1994	20:24	0.490µg/L				<0.080µg/L	<0.080µg/L		
PGSP0337	Jan/25/1994	08:24	0.620µg/L				<0.080µg/L	<0.080µg/L		
PGSP0338	Jan/25/1994	20:24	0.500µg/L				<0.080µg/L	<0.080µg/L		
PGSP0339	Jan/26/1994	08:24	0.530µg/L				<0.080µg/L	<0.080µg/L		
PGSP0340	Jan/26/1994	20:24	0.760µg/L				<0.080µg/L	<0.080µg/L		
PGSP0341	Jan/27/1994	08:50	0.870µg/L				<0.080µg/L	<0.080µg/L		
PGSP0342	Feb/02/1994	12:10	0.070µg/L				<0.080µg/L	<0.080µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0343	Feb/22/1994	11:20	0.720µg/L	0.320µg/L	<0.350µg/L		<0.080µg/L	<0.080µg/L	<0.023µg/L	<0.017µg/L
PGSP0344	Mar/01/1994	11:00	0.690µg/L				<0.080µg/L	<0.080µg/L		
PGSP0345	Mar/09/1994	09:00	1.300µg/L				<0.080µg/L	0.280µg/L		
PGSP0346	Mar/15/1994	15:57	1.500µg/L				<0.080µg/L	0.350µg/L		
PGSP0347	Mar/27/1994	05:30	1.000µg/L				<0.080µg/L	0.170µg/L		
PGSP0348	Mar/27/1994	06:10	0.910µg/L				<0.080µg/L	0.140µg/L		
PGSP0349	Mar/27/1994	06:50	0.900µg/L				<0.080µg/L	0.087µg/L		
PGSP0350	Mar/27/1994	07:30	0.720µg/L				<0.080µg/L	<0.080µg/L		
PGSP0351	Mar/27/1994	08:10	1.200µg/L				<0.080µg/L	<0.080µg/L		
PGSP0352	Mar/27/1994	09:30	1.400µg/L				<0.080µg/L	<0.080µg/L		
PGSP0353	Mar/27/1994	11:30	2.000µg/L				<0.080µg/L	<0.080µg/L		
PGSP0354	Mar/27/1994	13:30	2.600µg/L				<0.080µg/L	0.099µg/L		
PGSP0355	Mar/27/1994	14:30	2.400µg/L				<0.080µg/L	0.100µg/L		
PGSP0356	Mar/27/1994	15:30	2.700µg/L				<0.080µg/L	0.150µg/L		
PGSP0357	Mar/27/1994	16:30	2.400µg/L				<0.080µg/L	0.100µg/L		
PGSP0358	Mar/27/1994	17:30	1.100µg/L				<0.080µg/L	0.110µg/L		
PGSP0359	Mar/27/1994	18:30	1.900µg/L				<0.080µg/L	0.210µg/L		
PGSP0360	Mar/27/1994	22:30	1.600µg/L				<0.080µg/L	0.130µg/L		
PGSP0361	Mar/28/1994	02:30	1.900µg/L				<0.080µg/L	0.170µg/L		
PGSP0362	Mar/28/1994	06:30	1.900µg/L				<0.080µg/L	0.140µg/L		
PGSP0363	Mar/28/1994	10:30	1.900µg/L				<0.080µg/L	0.120µg/L		
PGSP0364	Mar/28/1994	13:30	2.000µg/L	1.150µg/L	<0.100µg/L	<0.500µg/L	<0.080µg/L	<0.250µg/L		
PGSP0365	Mar/28/1994	18:00	1.500µg/L				<0.080µg/L	0.170µg/L		
PGSP0366	Mar/29/1994	06:00	1.200µg/L				<0.080µg/L	0.190µg/L		
PGSP0367	Mar/29/1994	18:00	1.300µg/L				<0.080µg/L	0.170µg/L		
PGSP0368	Mar/30/1994	06:00	1.200µg/L				<0.080µg/L	0.140µg/L		
PGSP0369	Mar/30/1994	18:00	1.200µg/L				<0.080µg/L	0.160µg/L		
PGSP0370	Mar/31/1994	06:00	1.200µg/L				<0.080µg/L	0.160µg/L		
PGSP0371	Mar/31/1994	18:00	1.100µg/L				<0.080µg/L	0.160µg/L		
PGSP0372	Apr/01/1994	06:00	1.100µg/L				<0.080µg/L	0.110µg/L		
PGSP0373	Apr/01/1994	18:00	1.300µg/L				<0.080µg/L	0.110µg/L		
PGSP0374	Apr/02/1994	06:00	1.300µg/L				<0.080µg/L	0.160µg/L		
PGSP0375	Apr/02/1994	18:00	1.300µg/L				<0.080µg/L	0.140µg/L		
PGSP0376	Apr/03/1994	06:00	1.300µg/L				<0.080µg/L	0.140µg/L		
PGSP0377	Apr/03/1994	18:00	1.200µg/L				<0.080µg/L	0.130µg/L		
PGSP0378	Apr/04/1994	06:00	1.200µg/L				<0.080µg/L	0.140µg/L		
PGSP0379	Apr/04/1994	18:00	1.100µg/L				<0.080µg/L	0.130µg/L		
PGSP0380	Apr/05/1994	06:00	1.200µg/L				<0.080µg/L	0.110µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0381	Apr/05/1994	18:00	1.200µg/L				<0.080µg/L	0.150µg/L		
PGSP0382	Apr/06/1994	06:00	0.930µg/L				<0.080µg/L	0.120µg/L		
PGSP0383	Apr/06/1994	18:00	1.900µg/L				<0.080µg/L	0.200µg/L		
PGSP0384	Apr/07/1994	06:00	2.400µg/L				<0.080µg/L	0.230µg/L		
PGSP0385	Apr/07/1994	14:00	2.100µg/L				<0.080µg/L	0.300µg/L		
PGSP0387	Apr/11/1994	14:13	3.100µg/L				<0.080µg/L	<0.080µg/L		
PGSP0388	Apr/11/1994	17:57	3.000µg/L				<0.080µg/L	0.980µg/L		
PGSP0389	Apr/12/1994	07:30	2.900µg/L				<0.080µg/L	0.320µg/L		
PGSP0391	Apr/12/1994	15:30	2.500µg/L				<0.080µg/L	0.200µg/L		
PGSP0392	Apr/13/1994	06:15	2.600µg/L				<0.080µg/L	0.260µg/L		
PGSP0393	Apr/13/1994	18:00	2.200µg/L				<0.080µg/L	0.130µg/L		
PGSP0394	Apr/14/1994	06:00	1.900µg/L				<0.080µg/L	0.130µg/L		
PGSP0395	Apr/14/1994	18:00	1.800µg/L				<0.080µg/L	0.180µg/L		
PGSP0396	Apr/15/1994	06:00	1.700µg/L				<0.080µg/L	0.180µg/L		
PGSP0397	Apr/15/1994	18:00	1.600µg/L				0.170µg/L	0.120µg/L		
PGSP0398	Apr/16/1994	06:00	2.500µg/L				<0.080µg/L	0.350µg/L		
PGSP0399	Apr/16/1994	18:00	2.000µg/L				<0.080µg/L	0.230µg/L		
PGSP0400	Apr/17/1994	06:00	0.760µg/L				<0.080µg/L	0.200µg/L		
PGSP0401	Apr/17/1994	18:00	1.800µg/L				<0.080µg/L	0.160µg/L		
PGSP0402	Apr/18/1994	06:00	1.700µg/L				<0.080µg/L	0.160µg/L		
PGSP0403	Apr/18/1994	18:00	1.700µg/L				<0.080µg/L	0.140µg/L		
PGSP0404	Apr/19/1994	06:00	1.600µg/L				<0.080µg/L	0.160µg/L		
PGSP404A	Apr/20/1994	06:00	1.800µg/L				<0.080µg/L	0.340µg/L		
PGSP0405	Apr/21/1994	06:00	1.800µg/L				<0.080µg/L	0.240µg/L		
PGSP0406	Apr/22/1994	06:00	1.900µg/L				<0.080µg/L	0.300µg/L		
PGSP0407	Apr/23/1994	06:00	1.700µg/L				<0.080µg/L	0.290µg/L		
PGSP0408	Apr/24/1994	06:00	1.800µg/L				<0.080µg/L	0.320µg/L		
PGSP0409	Apr/25/1994	06:00	1.800µg/L				<0.080µg/L	0.340µg/L		
PGSP0410	Apr/26/1994	06:00	1.800µg/L				<0.080µg/L	0.560µg/L		
PGSP0411	Apr/27/1994	06:00	1.900µg/L				<0.080µg/L	0.200µg/L		
PGSP0412	Apr/27/1994	10:00	1.900µg/L	<0.100µg/L	<0.100µg/L		<0.080µg/L	0.320µg/L	<0.250µg/L	<0.100µg/L
PGSP0413	Apr/28/1994	06:00	1.900µg/L				<0.080µg/L	0.290µg/L		
PGSP0414	Apr/29/1994	06:00	1.800µg/L				<0.080µg/L	0.280µg/L		
PGSP0415	Apr/29/1994	18:00	1.900µg/L				<0.080µg/L	0.250µg/L		
PGSP0416	Apr/29/1994	18:45	2.000µg/L				0.180µg/L	0.430µg/L		
PGSP0417	Apr/29/1994	19:05	2.800µg/L				0.092µg/L	0.430µg/L		
PGSP0418	Apr/29/1994	19:09	2.700µg/L				<0.080µg/L	0.360µg/L		
PGSP0419	Apr/29/1994	19:25	2.800µg/L				0.130µg/L	0.430µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0420	Apr/29/1994	19:45	2.800µg/L				<0.080µg/L	0.450µg/L		
PGSP0421	Apr/29/1994	19:51	2.600µg/L				<0.080µg/L	0.340µg/L		
PGSP0422	Apr/29/1994	20:05	2.500µg/L				<0.080µg/L	0.350µg/L		
PGSP0423	Apr/29/1994	20:25	2.480µg/L				<0.080µg/L	0.400µg/L		
PGSP0424	Apr/29/1994	20:45	2.300µg/L				<0.080µg/L	0.470µg/L		
PGSP0425	Apr/29/1994	21:05	1.900µg/L				<0.080µg/L	0.500µg/L		
PGSP0426	Apr/29/1994	21:25	2.800µg/L				<0.080µg/L	0.330µg/L		
PGSP0427	Apr/29/1994	21:45	4.800µg/L				<0.080µg/L	0.370µg/L		
PGSP0428	Apr/29/1994	22:45	7.200µg/L				1.400µg/L	1.000µg/L		
PGSP0429	Apr/29/1994	23:45	6.400µg/L				5.700µg/L	1.700µg/L		
PGSP0430	Apr/30/1994	00:45	6.600µg/L				7.400µg/L	1.800µg/L		
PGSP0431	Apr/30/1994	01:45	6.000µg/L				5.700µg/L	1.700µg/L		
PGSP0432	Apr/30/1994	02:45	6.100µg/L				3.800µg/L	2.700µg/L		
PGSP0433	Apr/30/1994	03:45	6.000µg/L				3.800µg/L	3.800µg/L		
PGSP0434	Apr/30/1994	04:45	6.300µg/L				4.900µg/L	4.300µg/L		
PGSP0435	Apr/30/1994	05:45	5.900µg/L				5.200µg/L	4.500µg/L		
PGSP0436	Apr/30/1994	06:45	6.200µg/L				5.800µg/L	4.200µg/L		
PGSP0437	Apr/30/1994	07:45	5.800µg/L				4.700µg/L	3.600µg/L		
PGSP0438	Apr/30/1994	11:45	5.700µg/L				3.000µg/L	2.300µg/L		
PGSP0439	Apr/30/1994	15:45	5.000µg/L				1.100µg/L	1.400µg/L		
PGSP0440	May/01/1994	06:00	5.800µg/L				0.220µg/L	2.100µg/L		
PGSP0441	May/02/1994	06:00	4.080µg/L				<0.080µg/L	1.200µg/L		
PGSP0442	May/03/1994	06:00	2.600µg/L				0.087µg/L	0.390µg/L		
PGSP0443	May/04/1994	06:00	3.700µg/L				0.530µg/L	0.600µg/L		
PGSP0444	May/04/1994	18:00	3.300µg/L				0.530µg/L	0.680µg/L		
PGSP0445	May/05/1994	06:00	2.400µg/L				0.230µg/L	0.410µg/L		
PGSP0446	May/07/1994	06:00	1.900µg/L				<0.080µg/L	0.200µg/L		
PGSP0447	May/09/1994	06:00	2.200µg/L				0.140µg/L	0.270µg/L		
PGSP0448	May/11/1994	06:00	1.800µg/L				0.096µg/L	0.190µg/L		
PGSP0449	May/12/1994	09:00	1.500µg/L				0.089µg/L	0.180µg/L		
PGSP0450	May/13/1994	06:00	1.400µg/L				<0.080µg/L	0.240µg/L		
PGSP0451	May/14/1994	06:00	1.500µg/L				<0.080µg/L	0.230µg/L		
PGSP0452	May/15/1994	06:00	1.600µg/L				<0.080µg/L	0.200µg/L		
PGSP0453	May/15/1994	18:00	1.500µg/L				<0.080µg/L	0.210µg/L		
PGSP0454	May/16/1994	06:00	3.500µg/L				<0.080µg/L	0.360µg/L		
PGSP0455	May/17/1994	06:00	2.500µg/L				<0.080µg/L	0.400µg/L		
PGSP0456	May/18/1994	06:00	1.700µg/L				<0.080µg/L	0.120µg/L		
PGSP0457	May/20/1994	06:00	1.400µg/L				<0.080µg/L	<0.080µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0458	May/22/1994	06:00	1.200µg/L				<0.080µg/L	<0.080µg/L		
PGSP0459	May/24/1994	06:00	1.200µg/L				<0.080µg/L	<0.080µg/L		
PGSP0460	May/26/1994	06:00	1.200µg/L				<0.080µg/L	<0.080µg/L		
PGSP0461	May/28/1994	06:00	1.200µg/L				<0.080µg/L	<0.080µg/L		
PGSP0462	May/30/1994	06:00	1.100µg/L				<0.080µg/L	<0.080µg/L		
PGSP0463	Jun/01/1994	12:00	1.000µg/L				<0.080µg/L	<0.080µg/L		
PGSP0464	Jun/03/1994	06:00	1.000µg/L					<0.080µg/L		
PGSP0465	Jun/05/1994	06:00	0.990µg/L					<0.080µg/L		
PGSP0466	Jun/07/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0467	Jun/09/1994	06:00	1.200µg/L					0.130µg/L		
PGSP0468	Jun/10/1994	06:00	1.200µg/L					0.100µg/L		
PGSP0469	Jun/10/1994	11:01	1.400µg/L					0.150µg/L		
PGSP0470	Jun/10/1994	11:21	1.300µg/L					0.150µg/L		
PGSP0471	Jun/10/1994	11:41	1.300µg/L					0.160µg/L		
PGSP0472	Jun/10/1994	12:01	1.300µg/L					0.120µg/L		
PGSP0473	Jun/10/1994	12:21	1.300µg/L					0.150µg/L		
PGSP0474	Jun/10/1994	12:41	1.200µg/L					0.170µg/L		
PGSP0475	Jun/10/1994	13:01	1.300µg/L					0.130µg/L		
PGSP0476	Jun/10/1994	13:21	1.300µg/L					0.170µg/L		
PGSP0477	Jun/10/1994	13:41	1.300µg/L					0.140µg/L		
PGSP0478	Jun/10/1994	14:01	1.400µg/L					0.140µg/L		
PGSP0479	Jun/10/1994	15:01	1.400µg/L					0.150µg/L		
PGSP0480	Jun/10/1994	16:01	1.300µg/L					<0.080µg/L		
PGSP0481	Jun/10/1994	17:01	1.300µg/L					0.097µg/L		
PGSP0482	Jun/10/1994	18:01	1.400µg/L					<0.080µg/L		
PGSP0483	Jun/10/1994	19:01	1.200µg/L					<0.080µg/L		
PGSP0484	Jun/10/1994	20:01	1.200µg/L					<0.080µg/L		
PGSP0485	Jun/10/1994	21:01	1.300µg/L					<0.080µg/L		
PGSP0486	Jun/10/1994	22:01	1.300µg/L					<0.080µg/L		
PGSP0487	Jun/10/1994	23:01	1.300µg/L					<0.080µg/L		
PGSP0488	Jun/11/1994	00:01	1.200µg/L					<0.080µg/L		
PGSP0489	Jun/11/1994	04:01	1.200µg/L					<0.080µg/L		
PGSP0490	Jun/11/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0491	Jun/11/1994	08:01	1.300µg/L					<0.080µg/L		
PGSP0492	Jun/11/1994	12:01	1.300µg/L					<0.080µg/L		
PGSP0493	Jun/11/1994	16:01	1.100µg/L					<0.080µg/L		
PGSP0494	Jun/14/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0495	Jun/16/1994	06:00	0.990µg/L					<0.080µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0496	Jun/17/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0497	Jun/17/1994	21:13	1.100µg/L					<0.080µg/L		
PGSP0498	Jun/17/1994	21:33	1.100µg/L					<0.080µg/L		
PGSP0499	Jun/17/1994	21:53	1.100µg/L					<0.080µg/L		
PGSP0500	Jun/17/1994	22:13	1.100µg/L					<0.080µg/L		
PGSP0501	Jun/17/1994	22:33	1.100µg/L					<0.080µg/L		
PGSP0502	Jun/17/1994	22:53	1.100µg/L					<0.080µg/L		
PGSP0503	Jun/17/1994	23:13								
PGSP0504	Jun/17/1994	23:33	1.000µg/L					<0.080µg/L		
PGSP0505	Jun/17/1994	23:53	1.100µg/L					<0.080µg/L		
PGSP0506	Jun/18/1994	00:13	1.000µg/L					<0.080µg/L		
PGSP0507	Jun/18/1994	01:13	1.000µg/L					<0.080µg/L		
PGSP0508	Jun/18/1994	02:13	2.800µg/L					0.440µg/L		
PGSP0509	Jun/18/1994	03:13	3.500µg/L					0.720µg/L		
PGSP0510	Jun/18/1994	04:13	4.000µg/L					1.200µg/L		
PGSP0511	Jun/18/1994	05:13	3.800µg/L					1.500µg/L		
PGSP0512	Jun/18/1994	06:13	3.800µg/L					1.100µg/L		
PGSP0513	Jun/18/1994	07:13	4.100µg/L					1.600µg/L		
PGSP0514	Jun/18/1994	08:13	4.000µg/L					1.800µg/L		
PGSP0515	Jun/18/1994	09:13	3.900µg/L					1.800µg/L		
PGSP0516	Jun/18/1994	10:13	4.200µg/L					1.800µg/L		
PGSP0517	Jun/18/1994	14:13	3.800µg/L					1.500µg/L		
PGSP0518	Jun/18/1994	18:13	4.300µg/L					1.400µg/L		
PGSP0519	Jun/18/1994	22:13	3.600µg/L					1.300µg/L		
PGSP0520	Jun/19/1994	02:13	3.400µg/L					1.100µg/L		
PGSP0521	Jun/20/1994	06:00	1.400µg/L					0.160µg/L		
PGSP0522	Jun/22/1994	06:00	1.300µg/L					<0.080µg/L		
PGSP0523	Jun/24/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0524	Jun/26/1994	06:00	1.100µg/L					<0.080µg/L		
PGSP0525	Jun/29/1994	06:00	1.100µg/L					0.110µg/L		
PGSP0526	Jul/01/1994	06:00	1.000µg/L					0.110µg/L		
PGSP0527	Jul/03/1994	06:00	0.980µg/L					<0.080µg/L		
PGSP0528	Jul/05/1994	06:00	0.880µg/L					<0.080µg/L		
PGSP0529	Jul/06/1994	10:30	0.980µg/L					<0.080µg/L		
PGSP0530	Jul/07/1994	06:00	1.000µg/L					0.098µg/L		
PGSP0531	Jul/07/1994	06:30	1.000µg/L					0.180µg/L		
PGSP0532	Jul/07/1994	07:10	1.100µg/L					0.270µg/L		
PGSP0533	Jul/07/1994	11:30	1.300µg/L					3.100µg/L		

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Pleasant Grove Spring, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
PGSP0534	Jul/13/1994	06:00	1.100µg/L					0.210µg/L		
PGSP0535	Jul/20/1994	06:00	1.000µg/L					<0.080µg/L		
PGSP0537	Jul/25/1994	18:38	1.000µg/L					<0.080µg/L		
PGSP0538	Aug/03/1994	08:30	0.800µg/L					<0.080µg/L		
PGSP0539	Aug/16/1994	10:00	0.630µg/L					<0.080µg/L		
PGSP0540	Sep/08/1994	08:20	0.600µg/L					<0.080µg/L		
PGSP0541	Sep/19/1994	13:50	0.640µg/L					<0.080µg/L		
		Average*	1.844µg/L	.482µg/L	.214µg/L		.458µg/L	.409µg/L	.084µg/L	.044µg/L
		Maximum	7.200µg/L	1.150µg/L	.350µg/L		7.400µg/L	4.500µg/L	.250µg/L	.100µg/L
		Minimum	.070µg/L	.100µg/L	.100µg/L		.070µg/L	.060µg/L	.023µg/L	.017µg/L
		Standard Deviation	1.333	.396	.110		1.313	.749	.111	.038
		Coefficient Variation	.723	.821	.516		2.864	1.831	1.324	.861
		Number of Analyses	236	5	5	1	140	217	4	5

George Delaney swallow hole, October 1993–September 1994

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
GDSW0012	Dec/07/1993	11:40	1.100µg/L				<0.070µg/L	<0.060µg/L		
GDSW0013	Mar/28/1994	10:40	0.480µg/L				<0.080µg/L	<0.080µg/L		
GDSW0014	Apr/07/1994	15:00	2.100µg/L				<0.080µg/L	0.140µg/L		
GDSW0015	Apr/20/1994	12:10	0.900µg/L				<0.080µg/L	<0.080µg/L		
GDSW0016	Apr/26/1994	15:30	1.200µg/L				<0.080µg/L	<0.080µg/L		
GDSW0017	May/12/1994	09:50	1.300µg/L				<0.080µg/L	<0.080µg/L		
GDSW0018	May/17/1994	13:28	1.300µg/L				<0.080µg/L	<0.080µg/L		
GDSW0019	Jun/01/1994	07.36	1.100µg/L				<0.080µg/L	<0.080µg/L		
GDSW0020	Jun/15/1994	00:20	1.200µg/L					<0.080µg/L		
GDSW0021	Jul/06/1994	09:45	1.100µg/L					<0.080µg/L		
		Average*	1.178µg/L				.079µg/L	.084µg/L		
		Maximum	2.100µg/L				.080µg/L	.140µg/L		
		Minimum	.480µg/L				.070µg/L	.060µg/L		
		Standard Deviation	.403				.004	.021		
		Coefficient Variation	.342				.045	.246		
		Number of Analyses	10				8	10		

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Leslie Page karst window, October 1993–September 1994

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
LPKW0019	Oct/05/1993	13:20	0.120µg/L				<0.070µg/L	<0.060µg/L		
LPKW0020	Nov/09/1993	09:35	0.150µg/L					<0.060µg/L		
LPKW0021	Dec/07/1993	16:53	0.390µg/L				<0.070µg/L	<0.060µg/L		
LPKW0022	Jan/11/1994	14:23	0.340µg/L				<0.080µg/L	<0.080µg/L		
LPKW0023	Feb/02/1994	09:55	0.070µg/L				<0.080µg/L	<0.080µg/L		
LPKW0024	Feb/22/1994	13:30	0.570µg/L	0.220µg/L	<0.350µg/L		<0.080µg/L	<0.080µg/L	<0.023µg/L	<0.017µg/L
LPKW0026	Mar/10/1994	19:23	3.000µg/L				<0.080µg/L	1.900µg/L		
LPKW0027	Mar/10/1994	19:43	3.100µg/L				<0.080µg/L	1.500µg/L		
LPKW0028	Mar/10/1994	20:03	3.000µg/L				<0.080µg/L	2.100µg/L		
LPKW0029	Mar/10/1994	20:23	2.900µg/L				<0.080µg/L	2.100µg/L		
LPKW0030	Mar/10/1994	20:43	2.900µg/L				<0.080µg/L	2.000µg/L		
LPKW0031	Mar/10/1994	21:03	3.000µg/L				<0.080µg/L	2.000µg/L		
LPKW0032	Mar/10/1994	21:23	2.800µg/L				<0.080µg/L	1.700µg/L		
LPKW0033	Mar/10/1994	21:43	2.800µg/L				<0.080µg/L	2.000µg/L		
LPKW0034	Mar/10/1994	22:03	2.600µg/L				<0.080µg/L	1.900µg/L		
LPKW0035	Mar/10/1994	22:23	2.600µg/L				<0.080µg/L	1.800µg/L		
LPKW0036	Mar/10/1994	23:23	2.300µg/L				<0.080µg/L	1.400µg/L		
LPKW0037	Mar/11/1994	00:23	2.400µg/L				<0.080µg/L	1.400µg/L		
LPKW0038	Mar/11/1994	01:23	3.500µg/L				<0.080µg/L	2.800µg/L		
LPKW0039	Mar/11/1994	02:23	3.300µg/L				<0.080µg/L	2.500µg/L		
LPKW0040	Mar/11/1994	03:23	3.400µg/L				<0.080µg/L	2.300µg/L		
LPKW0041	Mar/11/1994	04:23	3.300µg/L				<0.080µg/L	2.500µg/L		
LPKW0042	Mar/11/1994	05:23	3.200µg/L				<0.080µg/L	2.600µg/L		
LPKW0043	Mar/11/1994	06:23	3.500µg/L				<0.080µg/L	2.500µg/L		
LPKW0044	Mar/11/1994	07:23	3.600µg/L				<0.080µg/L	2.600µg/L		
LPKW0045	Mar/11/1994	08:23	3.200µg/L				<0.080µg/L	2.500µg/L		
LPKW0046	Mar/11/1994	12:23	3.500µg/L				<0.080µg/L	2.500µg/L		
LPKW0047	Mar/11/1994	16:23	3.200µg/L				<0.080µg/L	2.300µg/L		
LPKW0048	Mar/11/1994	20:23	3.400µg/L				<0.080µg/L	2.300µg/L		
LPKW0049	Mar/12/1994	00:23	3.100µg/L				<0.080µg/L	2.200µg/L		
LPKW0050	Mar/15/1994	17:10	1.600µg/L				<0.080µg/L	0.650µg/L		
LPKW0051	Mar/27/1994	15:50	3.300µg/L				<0.080µg/L	2.100µg/L		
LPKW0052	Mar/28/1994	09:10	2.700µg/L				<0.080µg/L	2.000µg/L		
LPKW0053	Mar/28/1994	09:30	2.700µg/L				<0.080µg/L	1.100µg/L		
LPKW0054	Mar/28/1994	09:50	2.800µg/L				<0.080µg/L	1.200µg/L		
LPKW0055	Mar/28/1994	10:10	2.700µg/L				<0.080µg/L	1.200µg/L		
LPKW0056	Mar/28/1994	10:30	2.600µg/L				<0.080µg/L	1.100µg/L		
LPKW0057	Mar/28/1994	10:50	3.200µg/L				<0.080µg/L	1.100µg/L		
LPKW0058	Mar/28/1994	11:10	2.800µg/L				<0.080µg/L	1.100µg/L		
LPKW0059	Mar/28/1994	11:30	3.100µg/L				<0.080µg/L	1.100µg/L		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Leslie Page karst window, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
LPKW0060	Mar/28/1994	11:50	2.400µg/L				<0.080µg/L	1.100µg/L		
LPKW0061	Mar/28/1994	12:10	2.500µg/L				0.290µg/L	1.300µg/L		
LPKW0062	Mar/28/1994	12:30	2.500µg/L				<0.080µg/L	1.100µg/L		
LPKW0063	Mar/28/1994	13:30	2.600µg/L				<0.080µg/L	1.100µg/L		
LPKW0064	Mar/28/1994	14:30	2.400µg/L				<0.080µg/L	1.200µg/L		
LPKW0065	Mar/28/1994	15:30	2.400µg/L				<0.080µg/L	1.000µg/L		
LPKW0066	Mar/28/1994	16:30	2.500µg/L				<0.080µg/L	1.100µg/L		
LPKW0067	Mar/28/1994	17:30	2.400µg/L				<0.080µg/L	1.000µg/L		
LPKW0068	Mar/28/1994	18:30	2.300µg/L				<0.080µg/L	0.920µg/L		
LPKW0069	Mar/28/1994	19:30	2.500µg/L				<0.080µg/L	0.970 ug/		
LPKW0070	Mar/28/1994	20:30	2.100µg/L				<0.080µg/L	0.840µg/L		
LPKW0071	Mar/28/1994	21:30	2.300µg/L				<0.080µg/L	0.990µg/L		
LPKW0072	Mar/28/1994	22:30	2.400µg/L				<0.080µg/L	0.880µg/L		
LPKW0073	Mar/29/1994	02:30	2.000µg/L				<0.080µg/L	0.780µg/L		
LPKW0074	Mar/29/1994	06:30	1.900µg/L				<0.080µg/L	0.720µg/L		
LPKW0075	Mar/29/1994	10:30	1.800µg/L				<0.080µg/L	1.100µg/L		
LPKW0076	Mar/29/1994	14:30	1.700µg/L				<0.080µg/L	0.920µg/L		
LPKW0077	Apr/07/1994	10:55	1.600µg/L				<0.080µg/L	0.390µg/L		
LPKW0078	Apr/12/1994	08:06	3.400µg/L				<0.080µg/L	1.300µg/L		
LPKW0079	Apr/20/1994	08:15	1.800µg/L				<0.080µg/L	0.410µg/L		
LPKW0080	Apr/27/1994	08:31	1.600µg/L				<0.080µg/L	0.380µg/L		
LPKW0081	May/02/1994	12:23	2.000µg/L				<0.080µg/L	0.660µg/L		
LPKW0082	May/03/1994	06:00	1.600µg/L				<0.080µg/L	0.340µg/L		
LPKW0083	May/04/1994	06:00	1.800µg/L				<0.080µg/L	0.360µg/L		
LKPW0083	May/04/1994	06:00	1.800µg/L				<0.080µg/L	0.360µg/L		
LPKW0088	May/09/1994	06:00	1.300µg/L				<0.080µg/L	0.410µg/L		
LPKW0089	May/11/1994	06:00	1.200µg/L				<0.080µg/L	0.390µg/L		
LPKW0090	May/12/1994	10:40	1.100µg/L				<0.080µg/L	0.430µg/L		
LPKW0091	May/13/1994	06:00	1.300µg/L				<0.080µg/L	0.390µg/L		
LPKW0092	May/14/1994	06:00	1.300µg/L				<0.080µg/L	0.490µg/L		
LKPW0092	May/14/1994	06:00	1.300µg/L				<0.080µg/L	0.490µg/L		
LPKW0093	May/15/1994	06:00	1.300µg/L				<0.080µg/L	0.160µg/L		
LPKW0094	May/16/1994	06:00	1.100µg/L				<0.080µg/L	0.410µg/L		
LPKW0095	May/17/1994	06:00	1.600µg/L				<0.080µg/L	0.450µg/L		
LPKW0096	May/18/1994	06:00	1.500µg/L				<0.080µg/L	0.310µg/L		
LPKW0097	May/20/1994	06:00	1.200µg/L				<0.080µg/L	0.190µg/L		
LPKW0098	May/22/1994	06:00	1.200µg/L				<0.080µg/L	0.170µg/L		
LPKW0099	May/24/1994	06:00	1.200µg/L				<0.080µg/L	<0.080µg/L		
LPKW0100	May/25/1994	10:45	1.200µg/L				<0.080µg/L	0.250µg/L		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Leslie Page karst window, October 1993–September 1994 (Continued)

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
LPKW0101	May/27/1994	10:45	1.200µg/L				<0.080µg/L	0.210µg/L		
LPKW0102	May/29/1994	10:45	1.100µg/L				<0.080µg/L	0.200µg/L		
LPKW0103	May/31/1994	10:45	1.100µg/L				<0.080µg/L	0.190µg/L		
LPKW0104	Jun/01/1994	08:30	1.200µg/L				<0.080µg/L	0.210µg/L		
LPKW0105	Jun/15/1994	11:35	1.100µg/L					0.120µg/L		
LPKW0106	Jun/27/1994	23:50	0.910µg/L					0.320µg/L		
LPKW0107	Jun/28/1994	07:50	0.910µg/L					0.310µg/L		
LPKW0108	Jun/29/1994	07:50	0.900µg/L					0.280µg/L		
LPKW0109	Aug/02/1994	14:20	0.750µg/L					0.110µg/L		
		Average*	2.091µg/L				.082µg/L	1.048µg/L		
		Maximum	3.600µg/L				.290µg/L	2.800µg/L		
		Minimum	.070µg/L				.070µg/L	.060µg/L		
		Standard Deviation	.939				.023	.812		
		Coefficient Variation	.449				.283	.774		
		Number of Analyses	88	1	1		82	88	1	1

Upper Pleasant Grove Creek, October 1993–September 1994

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
UPGC0004	Nov/18/1993	11:31	1.100µg/L				<0.070µg/L	<0.060µg/L		
UPGC0005	Dec/07/1993	15:10	0.640µg/L				<0.070µg/L	<0.060µg/L		
UPGC0006	Feb/22/1994	15:16	0.770µg/L				<0.080µg/L	<0.080µg/L		
UPGC0007	Mar/28/1994	11:05	0.500µg/L				<0.080µg/L	<0.080µg/L		
UPGC0008	Apr/07/1994	10:25	1.900µg/L				<0.080µg/L	0.270µg/L		
UPGC0009	Apr/20/1994	12:25	1.000µg/L				<0.080µg/L	<0.080µg/L		
UPGC0010	Apr/27/1994	07:10	1.100µg/L				<0.080µg/L	<0.080µg/L		
UPGC0011	May/13/1994	10:10	1.400µg/L				<0.080µg/L	<0.080µg/L		
UPGC0012	May/17/1994	12:13	1.500µg/L				<0.080µg/L	<0.080µg/L		
UPGC0013	Jun/01/1994	07:07	1.000µg/L				<0.080µg/L	<0.080µg/L		
UPGC0014	Jun/15/1994	11:00	1.200µg/L					<0.080µg/L		
UPGC0015	Jul/06/1994	07:30	1.200µg/L					<0.080µg/L		
		Average*	1.109µg/L				.078µg/L	.093µg/L		
		Maximum	1.900µg/L				.080µg/L	.270µg/L		
		Minimum	.500µg/L				.070µg/L	.060µg/L		
		Standard Deviation	.383				.004	.056		
		Coefficient Variation	.345				.054	.610		
		Number of Analyses	12				10	12		

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

Miller Schoolhouse water well, October 1993–September 1994

Sample Number	Date	Time (CST)	Total ELISA Triazines	Total GC Atrazine	Total GC Simazine	Total GC Cyanazine	Total ELISA Carbofuran	Total ELISA Metolachlor	Total GC Metolachlor	Total GC Alachlor
MSHW0001	Apr/26/1994	14:00	0.070µg/L	<0.100µg/L	<0.100µg/L		<0.080µg/L	<0.080µg/L	<0.250µg/L	<0.100µg/L
		Number of Analyses	1	1	1		1	1	1	1

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the Basin.

APPENDIX J:
Bacteria Analyses and Descriptive Statistics for the Pleasant Grove Spring Drainage Basin

Pleasant Grove Spring, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
PGSP0001	Aug/02/1990	518 Col/100 ml	9000 Col/100 ml	.06 FC/FS
PGSP0002	Feb/28/1991	22 Col/100 ml	70 Col/100 ml	.31 FC/FS
PGSP0003	May/01/1991	136 Col/100 ml	70 Col/100 ml	1.94 FC/FS
PGSP0004	May/22/1991	236 Col/100 ml	1300 Col/100 ml	.18 FC/FS
PGSP0005	Jun/26/1991	418 Col/100 ml	16000 Col/100 ml	.03 FC/FS
PGSP0006	Jul/25/1991	118 Col/100 ml	110 Col/100 ml	1.07 FC/FS
PGSP0008	Sep/24/1991	3400 Col/100 ml	540 Col/100 ml	6.30 FC/FS
PGSP0009	Oct/22/1991	49 Col/100 ml	49 Col/100 ml	1.00 FC/FS
PGSP0011	Jan/29/1992	18 Col/100 ml	130 Col/100 ml	.14 FC/FS
PGSP0012	Feb/26/1992	2727 Col/100 ml	16000 Col/100 ml	.17 FC/FS
PGSP0013	Mar/25/1992	90 Col/100 ml	230 Col/100 ml	.39 FC/FS
PGSP0021	Apr/29/1992	108 Col/100 ml	920 Col/100 ml	.12 FC/FS
PGSP0026	May/27/1992	180 Col/100 ml	350 Col/100 ml	.51 FC/FS
	Average*	617 Col/100 ml	3444 Col/100 ml	.94 FC/FS
	Maximum	3400 Col/100 ml	16000 Col/100 ml	6.30 FC/FS
	Minimum	18 Col/100 ml	49 Col/100 ml	.03 FC/FS
	Standard Deviation	1104	6068	1.70
	Coefficient Variation	1.8	1.8	1.8
Total of 13 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Spring Valley karst window, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
SVKW0001	Aug/02/1990	23 Col/100 ml	300 Col/100 ml	.08 FC/FS
SVKW0002	Feb/28/1991	33 Col/100 ml	50 Col/100 ml	.66 FC/FS
SVKW0003	May/22/1991	345 Col/100 ml	920 Col/100 ml	.38 FC/FS
SVKW0004	Jun/26/1991	264 Col/100 ml	5400 Col/100 ml	.05 FC/FS
SVKW0005	Jul/25/1991	100 Col/100 ml	49 Col/100 ml	2.04 FC/FS
SVKW0007	Sep/24/1991	700 Col/100 ml	2400 Col/100 ml	.29 FC/FS
SVKW0008	Oct/22/1991	22 Col/100 ml	130 Col/100 ml	.17 FC/FS
SVKW0009	Jan/29/1992	18 Col/100 ml	220 Col/100 ml	.08 FC/FS
SVKW0010	Feb/26/1992	1364 Col/100 ml	16000 Col/100 ml	.09 FC/FS
SVKW0011	Mar/25/1992	90 Col/100 ml	330 Col/100 ml	.27 FC/FS
SVKW0013	Apr/29/1992	81 Col/100 ml	540 Col/100 ml	.15 FC/FS
SVKW0014	May/27/1992	297 Col/100 ml	170 Col/100 ml	1.75 FC/FS
	Average*	278 Col/100 ml	2209 Col/100 ml	.50 FC/FS
	Maximum	1364 Col/100 ml	16000 Col/100 ml	2.04 FC/FS
	Minimum	18 Col/100 ml	49 Col/100 ml	.05 FC/FS
	Standard Deviation	396	4610	.68
	Coefficient Variation	1.4	2.1	1.4
Total of 12 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
TCKW0001	Aug/02/1990	33 Col/100 ml	110 Col/100 ml	.30 FC/FS
TCKW0002	May/01/1991	11 Col/100 ml	49 Col/100 ml	.22 FC/FS
TCKW0003	May/22/1991	155 Col/100 ml	350 Col/100 ml	.44 FC/FS
TCKW0004	Jun/26/1991	91 Col/100 ml	3500 Col/100 ml	.03 FC/FS
TCKW0005	Jul/25/1991	9 Col/100 ml	94 Col/100 ml	.10 FC/FS
TCKW0007	Sep/24/1991	300 Col/100 ml	130 Col/100 ml	2.31 FC/FS
TCKW0009	Jan/29/1992	9 Col/100 ml	49 Col/100 ml	.18 FC/FS
TCKW0010	Feb/26/1992	18 Col/100 ml	350 Col/100 ml	.05 FC/FS
TCKW0011	Mar/25/1992	198 Col/100 ml	22 Col/100 ml	9.00 FC/FS
TCKW0013	Apr/29/1992	27 Col/100 ml	23 Col/100 ml	1.17 FC/FS
TCKW0014	May/27/1992	63 Col/100 ml	130 Col/100 ml	.48 FC/FS
	Average*	83 Col/100 ml	437 Col/100 ml	1.30 FC/FS
	Maximum	300 Col/100 ml	3500 Col/100 ml	9.00 FC/FS
	Minimum	9 Col/100 ml	22 Col/100 ml	.03 FC/FS
	Standard Deviation	96	1022	2.64
	Coefficient Variation	1.2	2.3	2.0
Total of 11 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Shackelford Spring, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
SKSP0001	Aug/02/1990	8 Col/100 ml	20 Col/100 ml	.40 FC/FS
SKSP0002	Feb/28/1991	4 Col/100 ml	14 Col/100 ml	.29 FC/FS
SKSP0003	May/01/1991	58 Col/100 ml	23 Col/100 ml	2.52 FC/FS
SKSP0004	May/22/1991	100 Col/100 ml	2400 Col/100 ml	.04 FC/FS
SKSP0005	Jul/25/1991	4 Col/100 ml	49 Col/100 ml	.08 FC/FS
SKSP0007	Sep/24/1991	82 Col/100 ml	240 Col/100 ml	.34 FC/FS
SKSP0008	Oct/22/1991	49 Col/100 ml	49 Col/100 ml	1.00 FC/FS
SKSP0010	Jan/29/1992	9 Col/100 ml	14 Col/100 ml	.64 FC/FS
SKSP0011	Feb/26/1992	54 Col/100 ml	130 Col/100 ml	.42 FC/FS
SKSP0012	Mar/25/1992	63 Col/100 ml	94 Col/100 ml	.67 FC/FS
SKSP0013	Apr/29/1992	10 Col/100 ml	5 Col/100 ml	2.00 FC/FS
SKSP0014	May/27/1992	81 Col/100 ml	240 Col/100 ml	.34 FC/FS
	Average*	44 Col/100 ml	273 Col/100 ml	.73 FC/FS
	Maximum	100 Col/100 ml	2400 Col/100 ml	2.52 FC/FS
	Minimum	4 Col/100 ml	5 Col/100 ml	.04 FC/FS
	Standard Deviation	35	675	.77
	Coefficient Variation	.8	2.5	1.1
Total of 12 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Thad Flowers bluehole, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
TFBH0001	Feb/28/1991	3 Col/100 ml	7 Col/100 ml	.43 FC/FS
TFBH0002	May/01/1991	14 Col/100 ml	7 Col/100 ml	2.00 FC/FS
TFBH0003	May/22/1991	7 Col/100 ml	540 Col/100 ml	.01 FC/FS
TFBH0004	Jun/26/1991	55 Col/100 ml	2400 Col/100 ml	.02 FC/FS
TFBH0005	Jul/25/1991	573 Col/100 ml	3500 Col/100 ml	.16 FC/FS
TFBH0008	Jan/29/1992	54 Col/100 ml	1700 Col/100 ml	.03 FC/FS
TFBH0009	Feb/26/1992	90 Col/100 ml	1600 Col/100 ml	.06 FC/FS
TFBH0010	Mar/25/1992	18 Col/100 ml	46 Col/100 ml	.39 FC/FS
	Average*	102 Col/100 ml	1225 Col/100 ml	.39 FC/FS
	Maximum	573 Col/100 ml	3500 Col/100 ml	2.00 FC/FS
	Minimum	3 Col/100 ml	7 Col/100 ml	.01 FC/FS
	Standard Deviation	193	1296	.67
	Coefficient Variation	1.9	1.1	1.7
Total of 8 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

George Delaney swallow hole, prior to June 1992

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
GDSW0001	May/22/1991	391 Col/100 ml	3500 Col/100 ml	.11 FC/FS
GDSW0002	Jun/26/1991	345 Col/100 ml	5400 Col/100 ml	.06 FC/FS
GDSW0003	Jul/25/1991	1800 Col/100 ml	3500 Col/100 ml	.51 FC/FS
GDSW0005	Jan/29/1992	126 Col/100 ml	920 Col/100 ml	.14 FC/FS
GDSW0006	Feb/26/1992	14000 Col/100 ml	24000 Col/100 ml	.58 FC/FS
GDSW0007	Mar/25/1992	540 Col/100 ml	490 Col/100 ml	1.10 FC/FS
	Average*	2867 Col/100 ml	6302 Col/100 ml	.42 FC/FS
	Maximum	14000 Col/100 ml	24000 Col/100 ml	1.10 FC/FS
	Minimum	126 Col/100 ml	490 Col/100 ml	.06 FC/FS
	Standard Deviation	5486	8860	.40
	Coefficient Variation	1.9	1.4	1.0
Total of 6 Analyses				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Pleasant Grove Spring, after October 1993

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform-Fecal Strep Ratio*
PGSP0344	Mar/01/1994	85 Col/100 ml	171 Col/100 ml	.497
PGSP0366	Mar/29/1994	800 Col/100 ml	4000 Col/100 ml	.200
PGSP0392	Apr/13/1994	1273 Col/100 ml	1441 Col/100 ml	.883
PGSP0412	Apr/27/1994	297 Col/100 ml	153 Col/100 ml	1.941
PGSP0449	May/12/1994	180 Col/100 ml	90 Col/100 ml	2.000
PGSP0463	Jun/01/1994	327 Col/100 ml	155 Col/100 ml	2.110
PGSP0529	Jul/06/1994	10 Col/100 ml	216 Col/100 ml	.046
	Average*	425 Col/100 ml	889 Col/100 ml	1.10 FC/FS
	Maximum	1273 Col/100 ml	4000 Col/100 ml	2.11 FC/FS
	Minimum	10 Col/100 ml	90 Col/100 ml	.05 FC/FS
	Standard Deviation	453	1453	.90
	Coefficient Variation	1.1	1.6	.8
Number of Analyses 7				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

The Canyon karst window, after October 1993

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform (Fecal/Strep Ratio)*
TCKW0015	Jun/01/1994	11 Col/100 ml	36 Col/100 ml	.306
TCKW0016	Jul/06/1994	10 Col/100 ml	1455 Col/100 ml	.007
	Average*	11 Col/100 ml	746 Col/100 ml	.16 FC/FS
Number of Analyses 2				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

George Delaney swallow hole, after October 1993

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform (Fecal/Strep Ratio)*
GDSW0019	Jun/01/1994	1100 Col/100 ml	1400 Col/100 ml	.786
GDSW0021	Jul/06/1994	1273 Col/100 ml	5364 Col/100 ml	.237
	Average*	1187 Col/100 ml	3382 Col/100 ml	.51 FC/FS
Number of Analyses 2				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

Leslie Page karst window, after October 1993

Sample Number	*Date*	*Fecal Coliform (Col/100 ml)*	*Fecal Streptococci (Col/100 ml)*	*Fecal Coliform (Fecal/Strep Ratio)*
LPKW0025	Mar/01/1994	7 Col/100 ml	9 Col/100 ml	.778
LPKW0080	Apr/27/1994	45 Col/100 ml	3636 Col/100 ml	.012
LPKW0090	May/12/1994	10 Col/100 ml	10 Col/100 ml	1.000
LPKW0104	Jun/01/1994	1 Col/100 ml	218 Col/100 ml	.005
LPKW0106	Jul/06/1994	10 Col/100 ml	2182 Col/100 ml	.005
	Average*	15 Col/100 ml	1211 Col/100 ml	.36 FC/FS
	Maximum	45 Col/100 ml	1211 Col/100 ml	.36 FC/FS
	Minimum	1 Col/100 ml	9 Col/100 ml	.00 FC/FS
	Standard Deviation	.17	1635	.49
	Coefficient Variation	1.2	1.4	1.4
Number of Analyses 5				

* These statistics are presented as a descriptive summary of the table. The effects of aliasing and variable sampling intervals may significantly affect the validity of averages presented as representative of ground-water quality in the basin.

86°59′30″ 55′ 86°50′30″

36°51′ 50′ 45′ 36°41′

RUSSELLVILLE (RM 995)

Green Downs Road

Ky. 96

Oakville Lane

Johnson-Young Road

Ky. 739

Harper Road

Omdorff Mill Rd.

Campground Rd.

Spring Valley Road

Williams Store

Oakville

Post Oak Ch

Cave Spring

Lebanon Ch

Ferguson

Dripping Springs Ch

Cedar Grove Sch

Bethany Ch

Millertown Ch

Red Oak Ch

Waitsboro Grove Ch

Lucketts Knob

Eagerton Knob

Halls Spark

Berea Ch

Mortimer Sta

Sibley

Whippoorwill Creek

Dry Fork

Little Barren River

GENERALIZED LAND USE AS OF FEBRUARY 1992

Pleasant Grove Spring Karst Ground-Water Drainage Basin, Logan County, Kentucky

SCALE 1:24,000

1 0 1 Mile

1000 0 1000 2000 3000 4000 5000 6000 7000 Feet

1 .5 0 1 Kilometer

EXPLANATION

- Pasture
- Crops
- Forested and other
- Ponds
- Ground-water basin boundary

PLATE 1

86°59′30″ 55′ 86°50′30″

36°51′ 50′ 45′ 36°41′

RUSSELLVILLE

Golf swallow hole
Sansom estavelle
Wilkin karst window
Spring View Spring
Toon swallow hole
Greenbriar Cave
Noe karst window
McKinney karst window
Crawdad estavelle
McCaleb karst window
Dye placed in creek detected only at Pleasant Grove Spring
Hindman sinkhole
Meyer karst window
Thad Flower bluehole (estavelle) (TFBH)
Rise of Little Whippoorwill
Ferguson Spring
Drinking Cup Cave
Shackelford sinkhole
Dawson Spring
Shackelford Spring (SKSP)
Scale karst window
Scale estavelle
Miles karst window
Upper Pleasant Grove Creek monitoring station (UPGC)
Smotherman Spring
Burnt House Spring
Poore Spring
Hickory Hill karst window
Piper estavelle
Joe Harper karst windows
Base flow only
Gooch sinkhole
Steve Blick Spring
Hobson Spring
17165
Harper "well"
Tadpole estavelle
Dripping Springs Cave
The Canyon karst window (TCKW)
17158 (MSHW)
Miller sinkhole
Delaney swallow hole (GDSW)
Wheatfield estavelle
Diverted into the Whippoorwill Creek
King Cave
King sinkhole
Leslie Page karst window (LPKW)
Long Spring
Poison Ivy karst window
Burchette Spring
Oakville Cave
Dotson Karst Window
Marvin Dotson sinkhole
Mason Spring
Kemper karst window
Johnson swallow hole
Spring Valley karst window (SVKW)
Blick Cave
Claude Blick Spring
Travis sinkhole
Collier Cave
Diverted in Pleasant Grove Creek
Pleasant Grove Spring (PGSP)
Roaring Well Cave
Pleasant Grove Barn Spring
Trailer karst window
Flowers Spring
Timmie karst window
Dotson Spring
Robinson karst window
Campbell bluehole

KARST FEATURES AND GROUND-WATER DYE-TRACE VECTORS

Pleasant Grove Spring Karst Ground-Water Drainage Basin, Logan County, Kentucky

SCALE 1:24,000

1 0 1 Mile

1000 0 1000 2000 3000 4000 5000 6000 7000 Feet

1 .5 0 1 Kilometer

EXPLANATION

- Spring
- Swallow hole
- Cave
- Estavelle
- Sinkhole
- Mapped cave
- Ground-water dye-trace vector
- Surface stream course
- Ground-water basin boundary
- (PGSP) Sample site designation
- Drilled well

PLATE 2

WATER-WELL LOCATIONS AND POTENTIOMETRIC SURFACE WITH HYPOTHESIZED FLOW ROUTES

Pleasant Grove Spring Karst Ground-Water Drainage Basin, Logan County, Kentucky

Water-level observations made between June 2, 1993, and September 13, 1993

PLATE 3

EXPLANATION

- Spring
- Swallow hole
- Hand-dug well
- Drilled well
- 17198 ● 599' — AKGWA* number, Elevation of water surface
- Diffuse-flow sub-basin
- Permanent stream course
- Intermittent stream course
- Hypothesized ground-water flow (route and direction; dashed where intermittent)
- 520' — Projected potentiometric surface contour lines (Feet above mean sea level)
- Ground-water basin boundary

*Kentucky Division of Water well-identification number.

SCALE 1:24,000

1 0 1 Mile

1000 0 1000 2000 3000 4000 5000 6000 7000 Feet

1 .5 0 1 Kilometer