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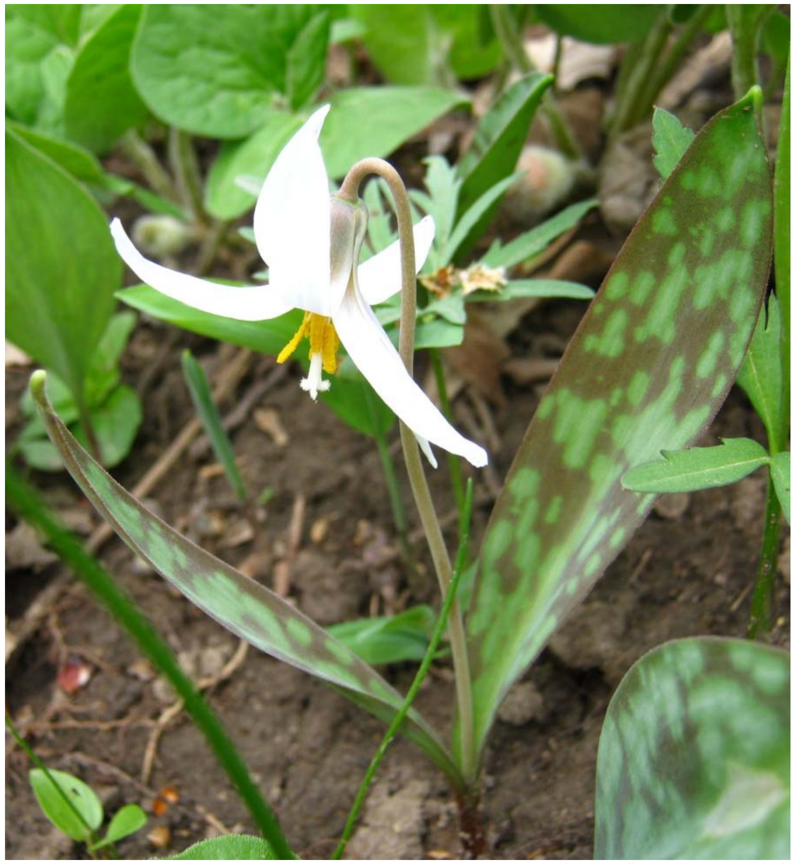
Water Quality in Black Partridge Creek Before and After Construction of I-355, Cook and Du Page Counties, Illinois

Eric T. Plankell



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Submitted under contract #ITHA RR-07-9918 to:

Illinois State Toll Highway Authority
2700 Ogden Ave
Downers Grove, IL 60515

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ILLINOIS STATE
GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

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ILLINOIS

EXECUTIVE SUMMARY

From May 2011 to May 2012, the ISGS collected surface-water samples and measured water-quality parameters in the Black Partridge Creek watershed, located in Cook and Du Page counties, Illinois. Water samples were analyzed to identify chemical constituents and their concentrations, and the results of this analysis were compared to samples collected prior to construction of the I-355 tollway, with the goal of determining whether roadway operations are having any measurable impact on water quality in the creek.

Analysis of water samples collected before and after construction of I-355 indicates that water quality in Black Partridge Creek has been and continues to be impacted as a result of roadway operations and surface-water runoff from developed areas within the watershed. Primary impacts to Black Partridge Creek associated with roadway deicing activities were documented in pre- and post-construction measurements of total dissolved solids, sodium, chloride, and post-construction measurements of specific conductivity, all of which followed distinct seasonal patterns with peaks occurring during the winter and spring months, concurrent with the regional deicing season. Highest mean and maximum TDS, sodium, and chloride levels were measured in the I-355 tributary and the east retention pond, and concentrations of these constituents increased in the creek downstream of these inputs. Furthermore, post-construction sodium and chloride concentrations in the creek remained elevated throughout the year with respect to background levels measured in a seep in Black Partridge Woods Nature Preserve, indicating that impacts to water quality from deicing were long lasting. Post-construction chloride concentrations, measured in grab samples and predicted by specific conductivity measurements recorded by data loggers, exceeded the General Use Standard for surface water (500 mg/L) at three locations in the creek, in the I-355 tributary, and in the east retention pond. Statistically significant increases in chloride and sodium were observed between samples collected from the I-355 tributary before and after construction of I-355, suggesting that deicing activities along I-355 are causing an increase in concentrations of these constituents in Black Partridge Creek.

Statistically significant decreases in mean concentrations of calcium, magnesium, alkalinity, and sulfate were measured in grab samples collected from Black Partridge Creek and the I-355 tributary following construction of I-355, though post-construction concentrations of calcium, magnesium, and alkalinity were comparable to values observed toward the end of pre-construction monitoring, suggesting these decreases may have pre-dated construction of I-355. The most likely cause of the observed decreases is increased surface-water runoff as a result of development within the watershed. Post-construction concentrations of calcium, magnesium, alkalinity, sulfur, and sulfate in the creek, retention ponds, and the I-355 tributary were generally lower than background levels measured in the seep, and the lowest levels were measured during the summer and fall, when precipitation and runoff amounts were greatest and thus diluted the creek. Wintertime peaks in calcium and magnesium were measured in the I-355 tributary, and might represent the presence of trace elements associated with deicing activities.

Total suspended solids were measured in post-construction grab samples only, and the highest concentrations were generally found in the creek, followed by the I-355 tributary, the retention ponds, and the seep. Most detections were measured in the upper reaches of the creek during the summer and fall, suggesting proximity to sources of sediment and organic matter, in addition to a higher concentration of impervious surfaces generating runoff as a means of mobilizing this material, are influential factors controlling the occurrence of total suspended solids.

Turbidity measurements collected by data loggers during post-construction monitoring showed turbidity was strongly correlated to precipitation, reflecting entrainment of sediment and organic matter during these events. Seasonally, turbidity levels were generally greatest in winter and spring, when plants were dormant or dead, and soils were more easily eroded. As with total suspended solids, for which turbidity is a measure, levels were generally higher at the upstream

locations, reflecting proximity to sources of sediment and high volumes of runoff capable of entraining that sediment.

Post-construction potassium concentrations were highest in the I-355 tributary, and remained elevated with respect to all other sample locations throughout the year. A statistically significant increase in mean potassium was determined for the I-355 tributary, likely due to increased potassium entering the tributary in trace minerals associated with the application of road salt on I-355, though the application of potassium-rich fertilizer to the surrounding landscape may also be a factor. At the same time, statistically significant decreases in mean potassium concentrations were measured at BPC3 and BPC6 in the creek, indicating that flow in the creek was being diluted, likely as a result of increased runoff due to development of the watershed.

Nitrate concentrations in the watershed have decreased significantly over time as a result of development and the subsequent removal of almost all agricultural land from the watershed. In post-construction samples, nitrate concentrations were greatest in the west retention pond, possibly as a result of seasonal application of fertilizer to the surrounding commercial landscape.

Total and dissolved non-volatile organic carbon concentrations were highest in samples from the I-355 tributary and BPC3, suggesting that runoff from I-355, Internationale Parkway, and I-55, along with runoff from other developed areas within the watershed, may be contributing excess NVOCs to the creek. Decreasing NVOC levels measured downstream are likely due to a combination of dilution by increasing groundwater inputs, settling out of organic matter, and uptake by biota.

Roadway metals of concern that were analyzed for this study include cadmium, chromium, nickel, lead, zinc, copper, and manganese. Copper, manganese, and lead concentrations decreased over time, with decreases beginning prior to the opening of I-355. However, these decreases were likely in part due to differences in sampling methods used in the pre- and post-construction phases of this study. In any case, post-construction concentrations of roadway metals in Black Partridge Creek did not appear to be influenced by runoff from I-355 or Bluff Road.

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INTRODUCTION

The Illinois State Geological Survey (ISGS) was contracted by the Illinois State Toll Highway Authority (Illinois Tollway) to characterize the geochemical conditions along the lower reaches of Black Partridge Creek within and adjacent to Black Partridge Woods Forest Preserve in Cook and Du Page counties, Illinois, (W1/2 Sections 18 and 19, T37N, R11E) (Figure 1) following construction of the Veterans Memorial Tollway (I-355). From May 2011 to May 2012, the ISGS collected monthly surface-water grab samples and continuously monitored water-quality parameters in the Black Partridge Creek watershed. This report details the methods, data, and conclusions derived from these sampling events, and compares these samples to others previously collected from Black Partridge Creek by the Illinois Natural History Survey (INHS) (Soluk et al. 2003).

This report was prepared under contract #ITHA RR-07-9918, and is limited to activities regarding the monitoring of water quality along Black Partridge Creek in Cook and Du Page counties, and does not address other activities contained within the above-referenced contract.

PURPOSE AND SCOPE

Construction of the south extension of the Veterans Memorial Tollway (hereafter referred to as I-355), between I-55 and I-80, began in 2004 and was completed in November 2007. The objective for this study was to determine if water quality in Black Partridge Creek has been impacted by runoff from this recently constructed stretch of tollway by comparing water quality before and after construction. Adding to the importance of this study is that the creek flows through Black Partridge Woods Nature Preserve, a dedicated Illinois nature preserve (Illinois Department of Conservation 1991) characterized by river bluffs, forested ravines, and calcareous seeps and springs. The creek then flows into an area of Black Partridge Woods Forest Preserve (Cook County Forest Preserve District) south of Bluff road, which contains potential larval habitat for the federally-endangered Hine's Emerald dragonfly (*Somatochlora hineana* Williamson) (Soluk et al. 2009, U.S. Fish and Wildlife Service 2013, Figure 1). This habitat is characterized by calcareous, groundwater-fed streamlets flowing through non-forested marsh overlying dolomitic bedrock in the Des Plaines River Valley. Hine's Emerald dragonflies (HEDs) are not known to occur within the nature preserve (i.e. north of Bluff Road), likely due to the thick forest canopy (Kristopher Lah, pers. comm.).

Post-construction water-quality samples were collected by the ISGS from May 2011 to May 2012 and were compared to pre-construction water-quality samples collected by the Illinois Natural History Survey (INHS) from March 1994 to September 2002 (Soluk et al. 2003). Additional supporting data utilized in this report include precipitation records collected from the Lewis University Airport weather station at Romeoville/Chicago (Midwestern Regional Climate Center 2014).

HYDROGEOLOGIC SETTING

LOCATION, INPUT, & TOPOGRAPHY

Black Partridge Creek lies within the Goose Lake-Des Plaines River hydrologic unit (HUC # 071200040905) (U.S. Department of Agriculture 2013). The present-day main channel of the creek originates northeast of the I-55/I-355 interchange, then flows in a southerly direction for approximately 5.3 km (3.3 mi) where it empties into the diversion channel of the Des Plaines River (Figures 1 and 2). The northern third of the stream has been channelized between I-55 and Internationale Parkway, while the southern two thirds is a meandering channel through forest preserves. Between I-55 and Internationale Parkway, Black Partridge Creek flows through residential and then light-industrial areas, with primary surface-water inputs coming from South Frontage Road, Woodward Avenue, and overflow from multiple large retention basins situated along the channel. Water in these retention basins is believed to be primarily generated as runoff

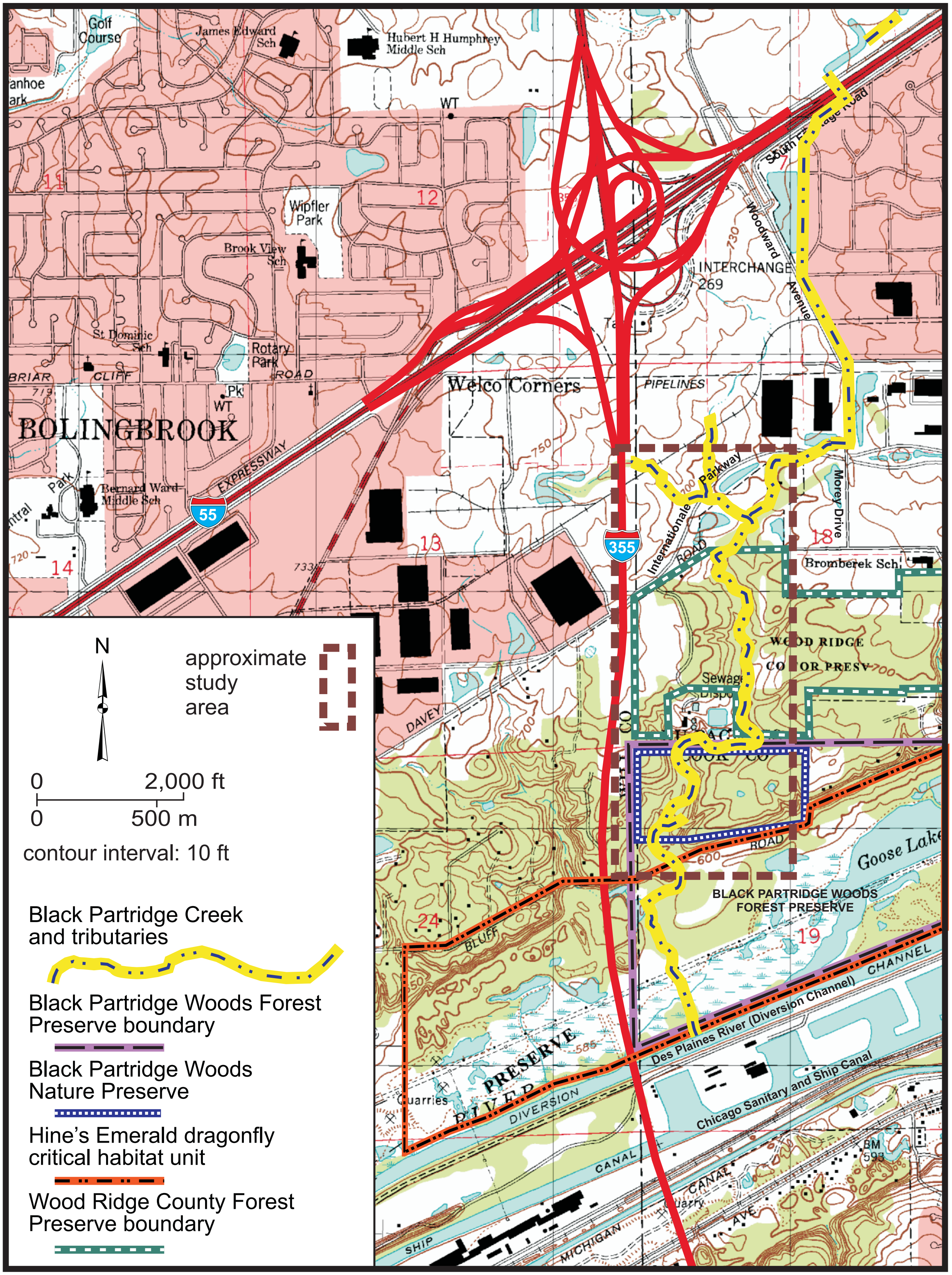


Figure 1. Map showing the location of Black Partridge Creek, Black Partridge Woods Nature Preserve, Wood Ridge and Black Partridge Woods forest preserves, and a critical habitat unit for the federally-endangered Hine's Emerald dragonfly (*Somatochlora hineana*). Figure modified from the1998 Romeoville, IL 7.5-minute U.S. Geological Survey Topographic Quadrangle (Illinois State Geological Survey 2014).

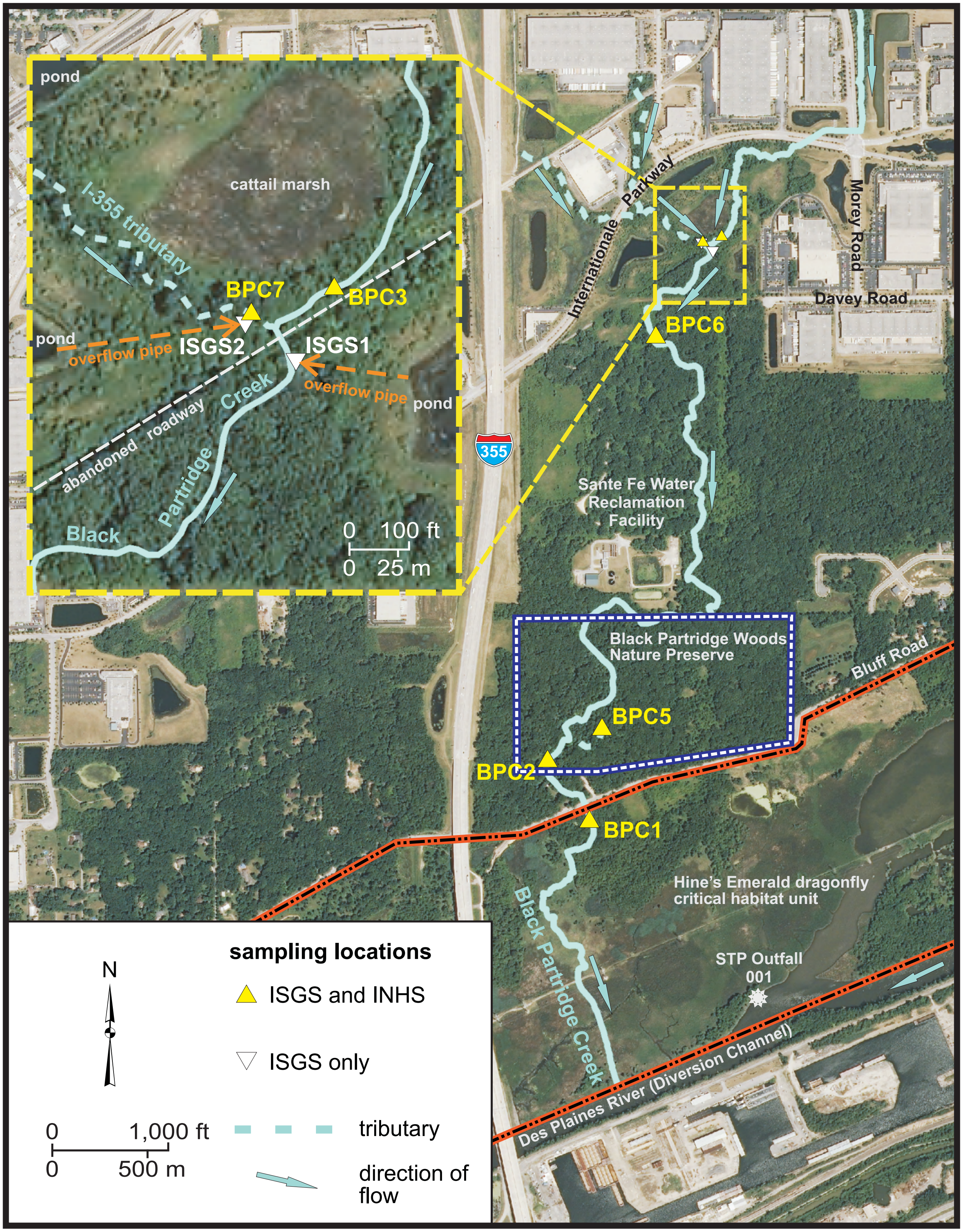


Figure 2. Sampling locations along Black Partridge Creek and its tributaries. Map based on 2012 Farm Service Agency digital orthophotography, Du Page County, Illinois (U.S. Department of Agriculture-Farm Service Agency 2012).

from the impervious surfaces of the many roadways, rooftops, and parking lots spread throughout the industrialized area.

South of Internationale Parkway, and north of an abandoned stretch of Davey Road, the creek meanders past a complex of forest, cattail marshes, and four additional retention basins. In addition to overflow from the wetlands and retention basins, this stretch of creek also receives surface water from a tributary that originates at I-355, flows southeast under Internationale Parkway, and joins the creek approximately 135 m (443 ft) north of the abandoned stretch of Davey Road. The total length of this tributary, from its origin at I-355 to where it joins Black Partridge Creek, is approximately 685 m (2,247 ft). South of Davey Road, Black Partridge Creek flows through the Wood Ridge Forest Preserve and wraps around the eastern and southern boundaries of the Sante Fe Water Reclamation Facility (NPDES Permit No. IL0032760). According to a Public Notice/Fact Sheet issued by the Illinois Environmental Protection Agency (IEPA) and dated October 12, 2006, the Sante Fe Water Reclamation Facility discharges directly into the diversion channel of the Des Plaines River upstream of Black Partridge Creek via STP Outfall 001, located at 41°40'30" N, 88°01'15" W (Illinois Environmental Protection Agency 2006, Figure 2). Therefore, discharge from the sewage treatment plant is not expected to have any impact on water quality in Black Partridge Creek.

The creek crosses into Cook County and continues through the Black Partridge Woods Forest Preserve before emptying into the diversion channel of the Des Plaines River. Surface-water inputs to the creek in this last section of the watershed include several groundwater-fed tributaries and runoff from Bluff Road.

Black Partridge Creek flows in a southerly direction, from an elevation of approximately 720 ft at its headwaters near I-55 to 585 ft at its mouth at the Des Plaines River diversion channel (Figure 1).

GEOLOGY

The uppermost bedrock unit underlying Black Partridge Creek is mapped as undifferentiated dolomite of the Silurian System (Kolata 2005). In northeastern Illinois, the Silurian System is composed predominantly of reef and interreef deposits of the Niagaran and underlying Alexandrian series (Willman et al. 1975). Reef rocks are commonly dolomite, while interreef rocks vary more typically from cherty silty dolomite to argillaceous dolomite (Willman et al. 1975). Depth to bedrock is mapped at less than 7.6 m (25 ft) (Piskin and Bergstrom 1975), and the buried bedrock surface underlying the region slopes gently to the southeast (Herzog et al. 1994).

Unconsolidated sediments at the site are mapped as less than 6 m (20 ft) of diamicton, deposited as till and ice-marginal sediment within the Valparaiso morainic system (Berg and Kempton 1988, Hansel and Johnson 1996). Continental glaciers advanced across the region several times during the Quaternary period, most recently during the Michigan Subepisode of the Wisconsin Episode, retreating approximately 15,000 years before present and depositing glacial till mapped as part of the Wadsworth Formation (Hansel and Johnson 1996). During and after the glaciers retreated, melt waters and discharges from various phases of Lake Michigan occurred at several times during the Late Wisconsin and Holocene, eroding the current Des Plaines River Valley and exposing dolomite bedrock.

METHODS

SAMPLING LOCATIONS

Grab samples of surface water for water-quality analysis were collected monthly from 8 locations within the Black Partridge Creek watershed (Figure 2), from May 2011 through May 2012. Six of these locations (BPC1, BPC2, BPC3, BPC5, BPC6, and BPC7) were previously sampled from March 1994 through September 2002 by the INHS (Soluk et al. 2003) prior to the construction of

I-355, and are described as follows from south to north. BPC1 and BPC2 (Photograph 1) are located in the stream channel approximately 38 m (125 ft) downstream and 166 m (545 ft) upstream of Bluff Road, respectively, and were re-visited for this study to assess water-quality impacts associated with Bluff Road as well as from inputs farther upstream. BPC1 is located within the Hine's Emerald dragonfly critical habitat unit (Figure 2). BPC5 is located along a tributary that flows into Black Partridge creek approximately 250 m (820 ft) upstream of Bluff Road. Specifically, BPC5 samples were collected at a seep issuing from the base of a bluff approximately 128 m (420 ft) upstream of the mouth of the tributary (Figure 2). Care was taken to collect the water at BPC5 just as it came to land surface before it had a chance to mix with any surface water that might have been present at that location, and these samples were subsequently used to document the local groundwater quality for comparison with the surface-water samples collected for this study. The BPC6 sample site is located in the main channel of the creek approximately 129 m (423 ft) downstream of a very large culvert under an abandoned stretch of Davey Road. Samples collected from this location are representative of the water quality resulting from mixing of the various surface-water inputs contributing to the headwaters of the stream north of the abandoned stretch of Davey Road. BPC3 is located in the main channel of the creek, approximately 36 m (118 ft) upstream of a culvert under a second, unnamed abandoned roadway. Samples collected from BPC3 represent surface-water quality as derived from the industrialized and residential areas surrounding the headwaters of Black Partridge Creek north of Internationale Parkway. Finally, sample site BPC7 (Photograph 2) is located at the mouth of a northwest-trending tributary of Black Partridge Creek (hereafter referred to as the I-355 tributary), approximately 15 m (49 ft) northwest of the unnamed abandoned roadway. The I-355 tributary originates in a drainage ditch for the northbound lanes of I-355, immediately south of the I-355/I-55 interchange. Samples collected at BPC7 document inputs to Black Partridge Creek from I-355 and Internationale Parkway, as well overflow from two additional retention ponds and intermittent flow from a tributary to the I-355 tributary that runs along the east side of the Champion Corporation Building (Figure 2). One location sampled by Soluk et al. (2003), BPC10, was not revisited during this study, as it was located upstream of the BPC3 location, and was deemed redundant for the purposes of this study.

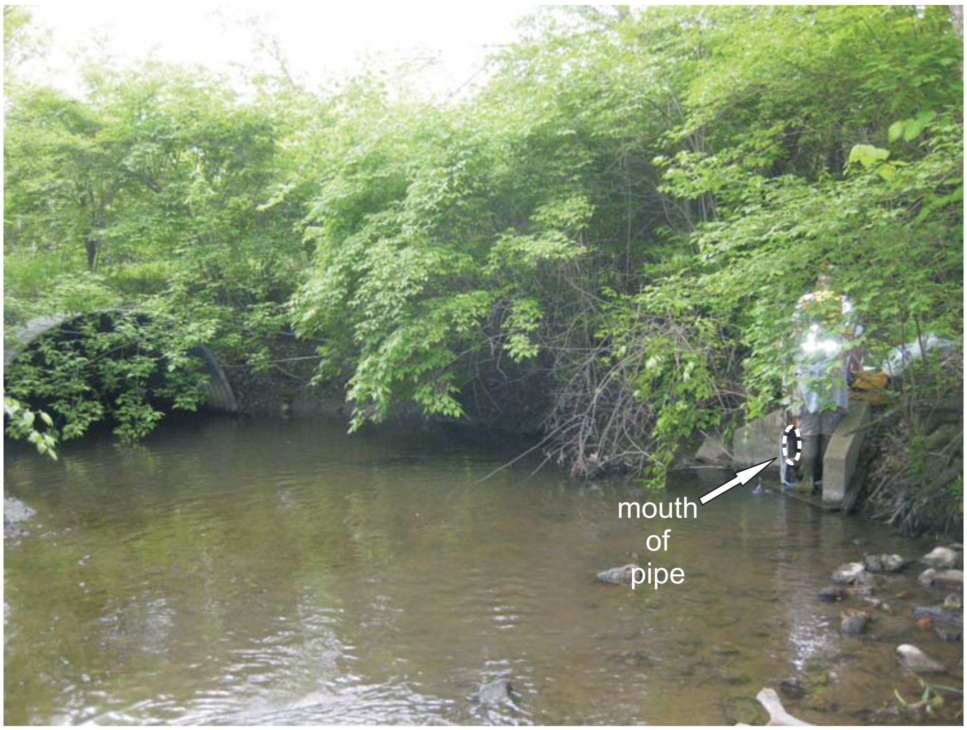
Two additional sampling locations (ISGS1 and ISGS2) were added to this study in an attempt to assess the quality of water flowing into Black Partridge Creek from the numerous retention ponds located within the developed area at the northern end of the watershed. ISGS1 (hereafter referred to as the east retention pond) was located in the mouth of an overflow pipe approximately 10 m (32.8 ft) southeast of the unnamed abandoned roadway (Photograph 3). Water from this pipe originates in a retention pond located approximately 57 m (187 ft) east of the creek that receives runoff from the parking lot of a business located in the northwest quadrant of Davey Road and Morey Road (Figure 2). ISGS2 (hereafter referred to as the west retention pond) was located in the mouth of an overflow pipe approximately 15 m (49 ft) northwest of the unnamed abandoned roadway and approximately 2 m (6.6 ft) south of the BPC7 sampling location at the mouth of the I-355 tributary (Photograph 2). Water from this pipe originates in a retention pond that receives runoff from Internationale Parkway and is located approximately 91 m (299 ft) west of the creek (Figure 2).

GRAB SAMPLE COLLECTION AND PRESERVATION

Surface-water grab samples were collected using a peristaltic pump with silicone tubing attached to a flow-through cell connected to a Hydrolab MS5 multiparameter water-quality data logger. The data logger was used to check for stabilization of field parameters prior to sampling, including temperature, pH, specific conductivity, and turbidity. Samples collected for analysis of dissolved non-volatile organic carbon, metals, anions, total dissolved solids (TDS), and phosphate were filtered in the field using 0.45-micron disposable filters. Samples collected for analysis of metals, total and dissolved non-volatile organic carbon, and ammonia-nitrogen were preserved in the field with acid (0.2% nitric acid, 0.5% phosphoric acid, 0.5% phosphoric acid, and 0.2% sulfuric acid, respectively), and all samples were placed on ice for transport back to the Illinois State Water

Photograph 1. ISGS grab sample location BPC2. Samples were collected from the main channel of Black Partridge Creek, immediately downstream of the medium-size tree overhanging the east bank. View oriented to the north-northeast.

Photograph 2. ISGS grab sample locations BPC7 and ISGS2. The mouth of the tributary where BPC7 samples were collected is hidden in the brush immediately behind the root extending right of the concrete structure. ISGS2 samples were collected from just inside the iron pipe, while the ISGS2 Hydrolab was deployed at the base of the concrete structure. View oriented to the northwest.



Photograph 3. ISGS grab sample location ISGS1. Samples were collected from just inside the iron pipe. ISGS1 is located on the east bank immediately downstream of the large culvert, visible at left-center above, which channels Black Partridge Creek under an unnamed abandoned roadway. View oriented to the north.

Survey Public Service Laboratory, in Champaign, Illinois, within laboratory-specified holding times. All samples were analyzed for the following geochemical parameters: metals, anions, TDS, total suspended solids (TSS), phosphate, pH, alkalinity, ammonia-nitrogen, and total and dissolved non-volatile organic carbon; refer to Appendix A for a complete list of analytes measured and the methodologies used.

Eleven sampling trips were completed for this project, and each site was sampled eleven times, except for the I-355 tributary (BPC7) which was not sampled on May 19, 2011 or January 11, 2012 due to a lack of flowing water. Field parameters and the results of geochemical analysis of the grab samples are presented in Appendix B. One duplicate sample and one trip blank were collected during each of the eleven sampling trips to provide quality control according to laboratory protocols. Appendices C and D present the geochemical results of the duplicate and blank samples, respectively. A total of 108 sample sets were collected and analyzed for the post-construction portion of this study.

CONTINUOUS MONITORING OF SURFACE-WATER QUALITY

In addition to collecting surface-water grab samples, and in order to regularly monitor water quality at these locations between sampling trips, Hydrolab MS5 water-quality data loggers were installed at BPC1 and BPC3 on May 18, 2011, and at the west retention pond (ISGS2) on June 21, 2011. Water-quality parameters were measured by each data logger every 4 hours, and included pH, temperature, specific conductivity, and turbidity. The data loggers were strategically placed at these locations to assess conditions in the upstream and downstream portions of the stream (BPC3 and BPC1, respectively) as well as to assess the quality of the water coming from one of the many retention ponds in the developed northern reaches of the project area (west retention pond/ISGS2). The data logger at the west retention pond was deployed in the streambed at the base of the concrete structure supporting the overflow pipe for the pond (Photograph 2), with the sensors positioned such that they were directly in the path of water flowing from the pipe. However, during periods of intense rainfall, an increase in water volume flowing from the I-355 tributary may have mixed with water from the west retention pond, thus affecting the measurements recorded by the data logger. Data from the west retention pond data logger have been interpreted with this possibility in mind.

Hydrolabs were downloaded and calibrated with standards every month during sampling trips, according to the Hydrolab Minisonde 5 manual (Hach Company 2006). From the start of post-construction monitoring through January 11, 2012, self-cleaning turbidity sensors on the Hydrolabs were calibrated to a formazine solution diluted to 100 NTU. Beginning on February 23, 2012, an undiluted formazine solution (1,000 NTU) was used to calibrate the turbidity sensors. Hydrolab data were carefully examined for accuracy. During analysis, data deemed unreliable or not representative of actual flow (i.e. collected when sensors were exposed to air due to little or no flow at the sampling site or when a data logger was temporarily out of the water for downloading or maintenance), were removed for quality control. The logger at the west retention pond stopped functioning on November 19, 2011, and a replacement logger was not installed at that location until December 16, 2011, resulting in a gap in the data for this location.

PRECIPITATION

Precipitation data recorded at the Lewis University Airport weather station at Romeoville/Chicago during the post-construction phase of this study were obtained from the Midwestern Regional Climate Center (MRCC) at the Illinois State Water Survey (ISWS) (Midwestern Regional Climate Center 2014). The weather station is located approximately 9.8 km (6.1 mi.) southwest of Black Partridge Creek Forest Preserve, and the data downloaded included daily and monthly precipitation totals as well as the 30-year average monthly precipitation calculated for 1981-2010. These data were used to identify seasonal patterns observed in the analytical results for the monthly grab samples, to assess the more rapid changes observed in water-quality parameters that were recorded by the three data loggers deployed in the watershed, and to compare conditions to means calculated for both grab samples and data-logged measurements.

DATA AND ANALYSIS

Data analyzed for this report include: 1) precipitation records from the nearby Lewis University Airport weather station, 2) concentrations of analytes occurring in surface-water grab samples collected by the ISGS following construction of I-355, 3) water-quality parameters measured in surface water by ISGS-deployed data loggers, and 4) concentrations of analytes occurring in surface-water grab samples collected by the INHS prior to construction of I-355.

PRECIPITATION

Monthly precipitation totals recorded at the Lewis University Airport weather station between May 1, 2011 and May 31, 2012 are presented in relation to 30-year monthly averages (calculated from 1981-2010) in Figure 3. Daily precipitation totals measured at the weather station between May 1, 2011 and May 1, 2012 are presented in relation to ISGS sampling dates in Figure 4. Total rainfall recorded between May 1, 2011 and May 31, 2012 was 46.66 inches, which is 105% of the 30-year average (44.33 inches).

Average precipitation trends generally occurred throughout the study period (i.e. highest totals measured from May-August and then declining gradually through fall and winter before climbing again in the spring), though some notable exceptions occurred. In June 2011, 8.82 inches of rain (203% of normal) were recorded, including the largest daily total for the study period (4.64 inches) which was recorded on June 9, 2011 (Figure 4). The lowest monthly amount of precipitation recorded in relation to the 30-year average occurred in April 2012 and was approximately 50% of normal.

POST-CONSTRUCTION GRAB SAMPLES AND WATER-QUALITY PARAMETERS

The presence and concentrations of geochemical constituents in the Black Partridge Creek watershed were determined through laboratory analysis of surface-water grab samples collected by the ISGS between May 18, 2011 and May 1, 2012, following construction of I-355. Complete analytical results of these samples are provided in Appendix B, including minimum, maximum, and mean concentrations, and the number and percentage of detections recorded for each analyte. Groundwater quality within the watershed is characterized by samples collected from the seep at BPC5, water quality in the main stream channel is characterized by samples from BPC1, BPC2, BPC3, and BPC6, water quality in the I-355 tributary is characterized by samples from BPC7, and water quality in the retention ponds (representing runoff captured from the developed areas) is characterized by samples from ISGS1 (east retention pond) and ISGS2 (west retention pond). Potential impacts to Black Partridge Creek from the I-355 tributary are explored by comparing samples collected upstream and downstream from where the tributary enters the creek (BPC3 and BPC6, respectively) and potential impacts from Bluff Road are examined through comparisons of samples collected upstream and downstream of the roadway (BPC2 and BPC1, respectively).

The ISGS is currently involved in another study along the I-294 tollway in Cook County, Illinois, and has determined that the highest analyte masses in tollway runoff are generally, in order from highest to lowest, TDS, chloride, sodium, sulfate, TSS, alkalinity, calcium, sulfur, total and/or dissolved nonvolatile organic carbon, and potassium (Miner et al. 2014). Particular attention to the detection and concentrations of these analytes is given in this study. Table 1 provides a summary of minimum, maximum, and mean concentrations of selected analytes that are discussed in detail below, and Figure 5 presents graphs of these analytes as an aid to analysis.

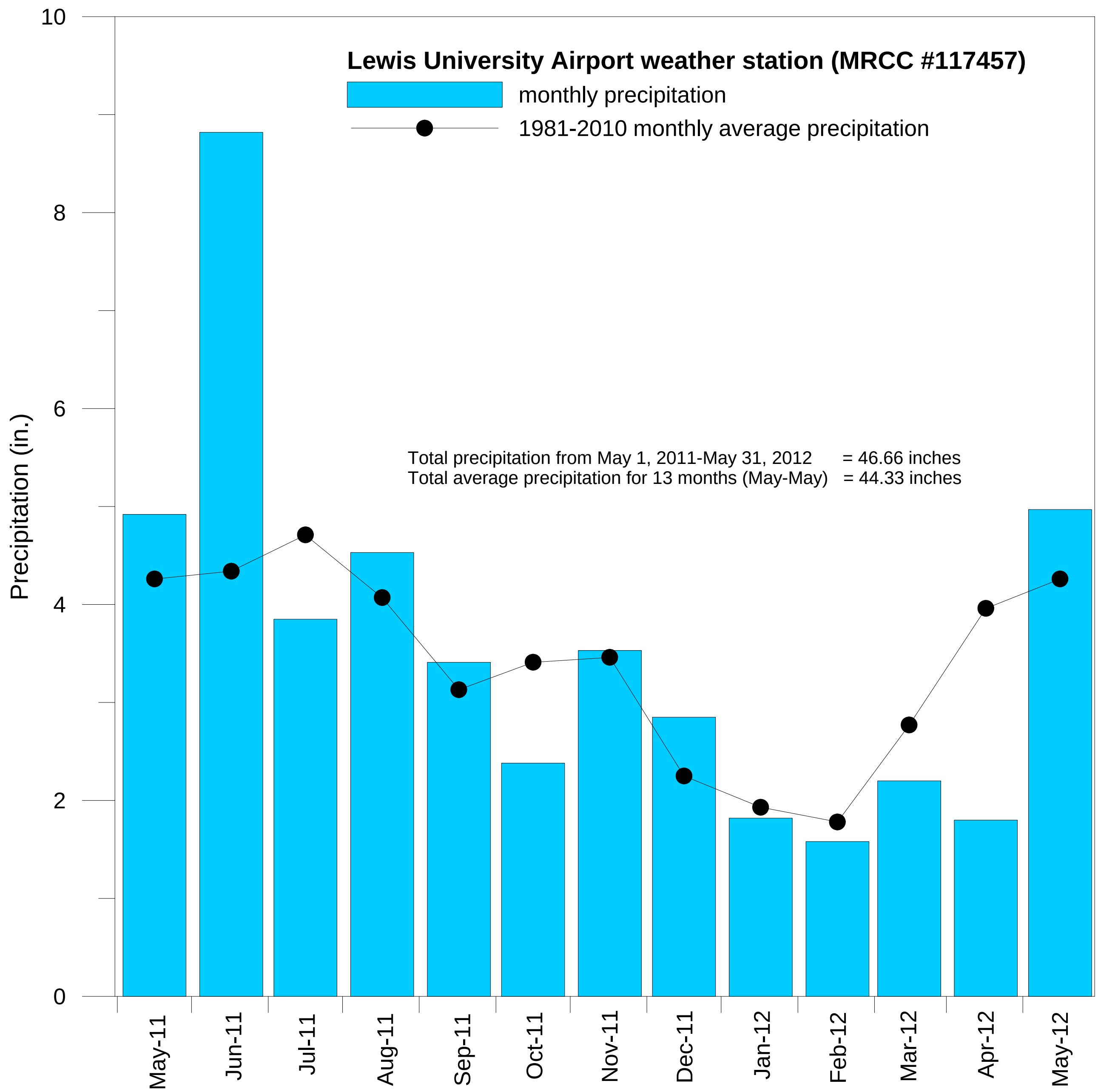


Figure 3. Monthly vs. 30-year average precipitation recorded at the Lewis University Airport weather station at Romeoville/Chicago (MRCC station #117457) (Midwestern Regional Climate Center 2014).

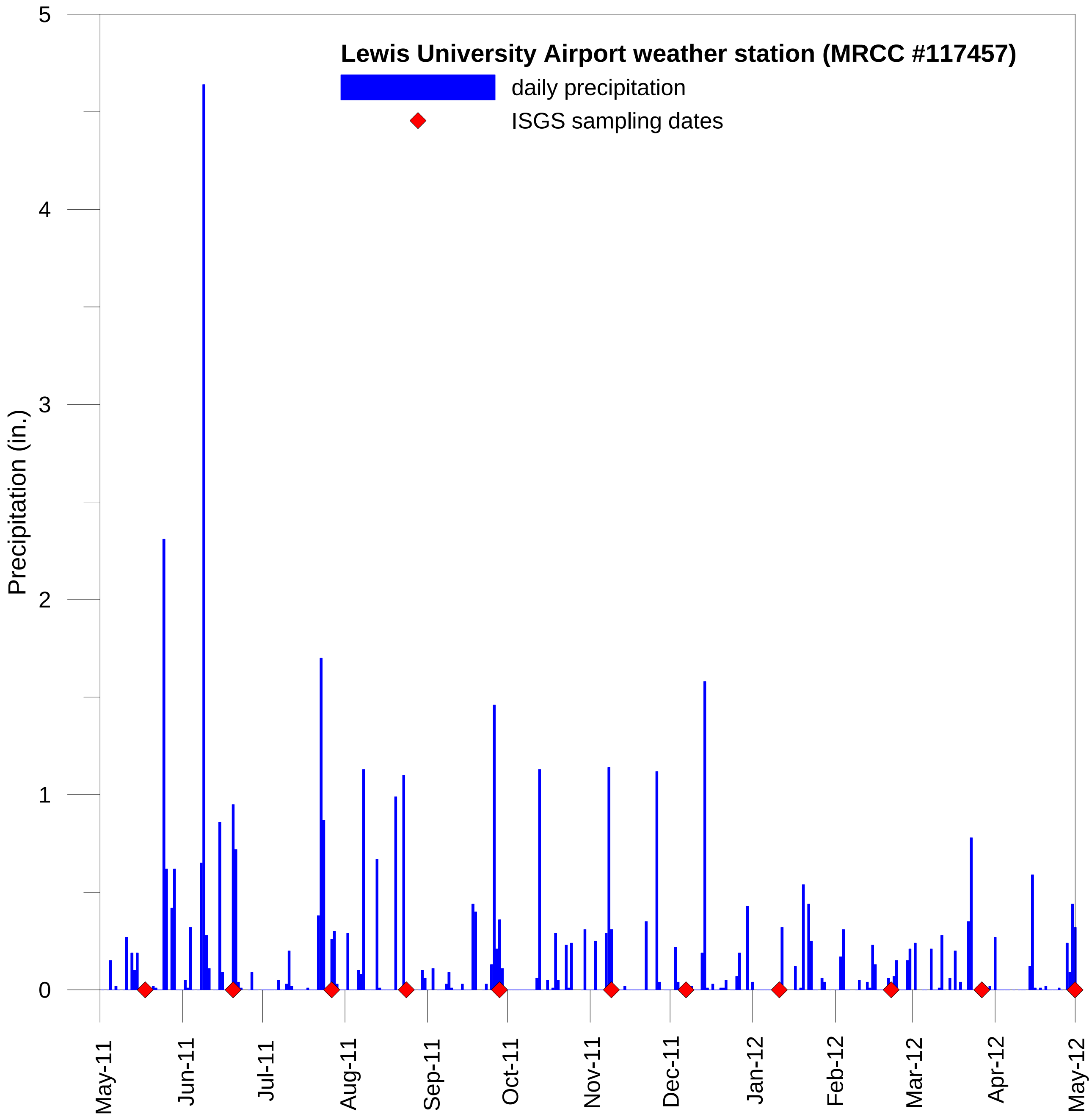


Figure 4. Daily precipitation recorded at the Lewis University Airport weather station at Romeoville/Chicago (MRCC station #117457) (Midwestern Regional Climate Center 2014).

Table 1. Concentrations of selected analytes in post-construction grab samples.

sample location		Total Dissolved Solids	Sodium	Chloride	Calcium	Magnesium	Alkalinity	Sulfur	Sulfate	Total Suspended Solids	Potassium	Nitrate	Total Non-Volatile Organic Compounds	Dissolved Non-Volatile Organic Compounds	Copper	Manganese
Seep																
BPC5	*min*	**691**	64.0	129	**109**	**50.5**	**337**	**32.7**	**91.9**	-	3.04	0.10	0.52	0.48	0.0009	0.0024
	max	797	81.0	149	121	**56.5**	**343**	**39.8**	**110**	-	3.75	0.19	1.71	1.43	0.0009	0.0083
	mean	716	72.7	136	**113**	**53.1**	**341**	**36.0**	**103**	-	3.44	0.13	1.19	1.16	0.0009	0.0057
I-355 Tributary																
BPC7	*min*	481	**129**	**173**	32.5	12.2	112	6.8	19.0	3.2	**5.14**	0.05	3.33	3.38	**0.0012**	0.0016
	max	**1,896**	518	951	**122**	51.6	248	27.9	80.0	22.4	**9.62**	0.10	10.53	**9.01**	0.0015	0.0140
	mean	**956**	**259**	**438**	63.6	25.9	160	15.0	42.4	9.2	**7.57**	0.08	7.44	**6.87**	0.0013	0.0065
In-stream (upstream to downstream)																
BPC3	*min*	339	78.4	112	30.3	14.0	105	9.8	27.6	3.2	2.35	0.07	**3.84**	3.41	0.0011	0.0095
	max	1,182	303	534	91.5	39.5	229	26.1	75.2	**47.6**	3.51	0.43	**13.25**	7.18	0.0024	0.0412
	mean	700	166	273	57.7	26.2	165	17.9	51.5	**15.4**	3.04	0.2	**7.47**	5.90	0.0019	**0.024**
BPC6	*min*	428	102	150	35.5	14.1	108	9.3	25.9	3.2	2.45	0.09	3.75	**3.58**	0.0010	**0.0096**
	max	1,228	319	574	94.4	38.5	219	26.6	74.3	18.8	3.78	0.43	9.24	7.14	0.0022	**0.0618**
	mean	717	175	287	57.5	25.2	162	17.7	50.3	12.5	3.24	0.2	6.90	5.85	0.0015	0.023
BPC2	*min*	403	95.4	142	34.9	14.0	115	8.9	24.9	**6.0**	2.42	0.08	3.01	2.87	0.0009	0.0042
	max	1,171	276	501	94.5	43.1	249	29.1	82.7	28.4	3.74	0.32	9.42	6.95	0.0032	0.0130
	mean	698	155	256	63.9	28.7	182	20.0	57.1	12.2	3.29	0.2	5.86	5.02	0.0016	0.0070
BPC1	*min*	401	94.1	133	32.5	12.5	107	8.2	23.1	5.6	2.35	0.09	2.71	2.59	0.0009	0.0049
	max	1,163	276.2	496	95.4	43.5	253	29.3	83.1	39.2	3.81	0.33	9.90	7.10	0.0030	0.0184
	mean	705	156	256	65.1	29.1	184	20.3	57.3	14.3	3.33	0.2	5.78	5.08	0.0014	0.0072
East Retention Pond																
ISGS1	*min*	160	30.0	44.8	18.4	6.17	50	4.9	13.7	3.6	0.979	0.09	3.72	3.25	0.0008	0.0086
	max	1,789	**566**	**963**	75.0	30.6	114	20.0	52.3	3.6	3.49	0.91	7.67	6.83	0.0009	0.0433
	mean	643	188	310	36.4	14.5	79	10.0	27.8	3.6	1.85	0.3	5.47	4.82	0.0008	0.018
West Retention Pond																
ISGS2	*min*	215	42.2	60.4	23.5	9.02	78	6.6	18.0	3.2	1.79	**0.15**	3.63	3.54	0.0008	0.0031
	max	952	247	420	65.2	27.7	146	24.9	68.3	7.2	2.22	**2.52**	8.16	7.11	**0.0048**	0.0131
	mean	455	106	167	38.8	16.0	109	14.1	40.7	5.4	2.07	**0.63**	6.18	5.31	**0.0021**	0.0064
highest minimum value																
highest maximum value																
highest mean value																

*All concentrations reported as mg/L.

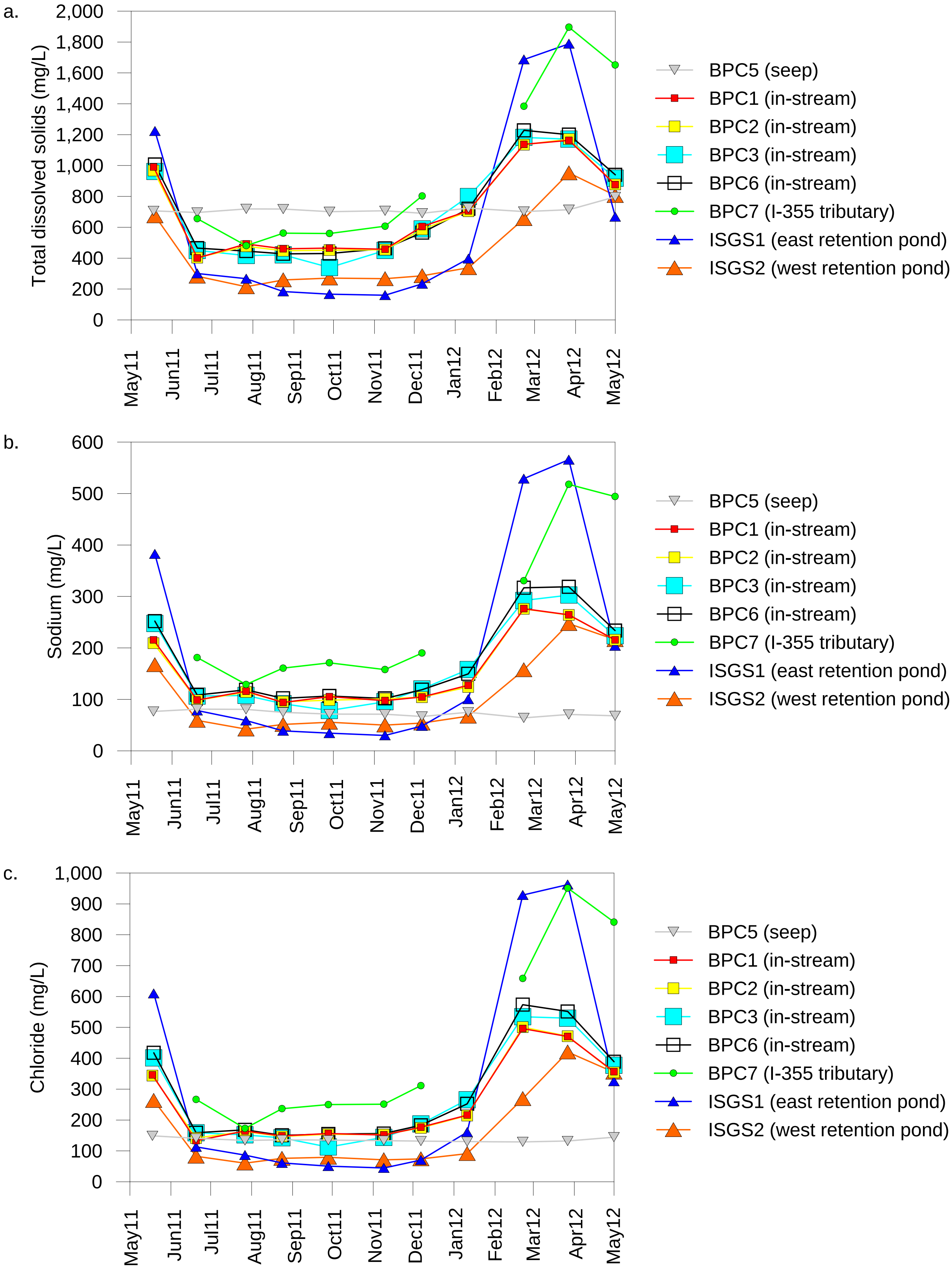


Figure 5. Concentrations of selected analytes measured in grab samples from the Black Partridge Creek watershed following construction of I-355.

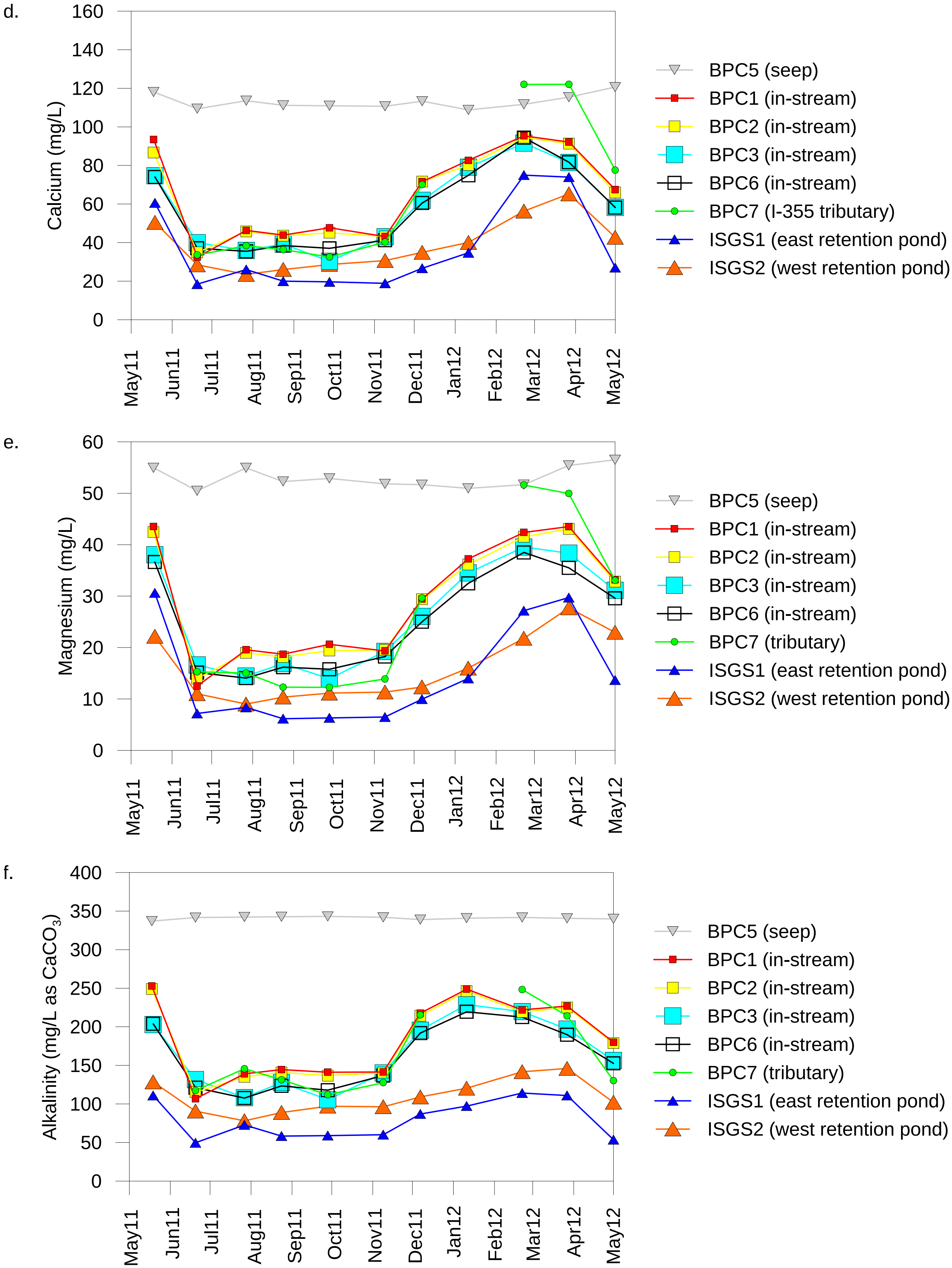
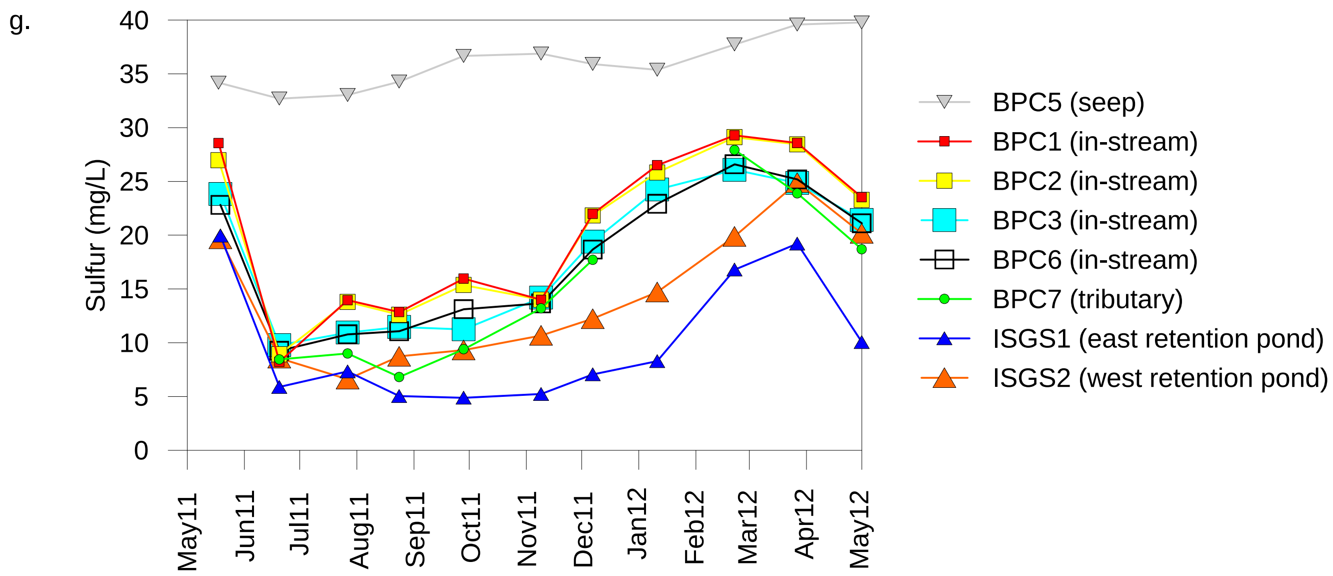
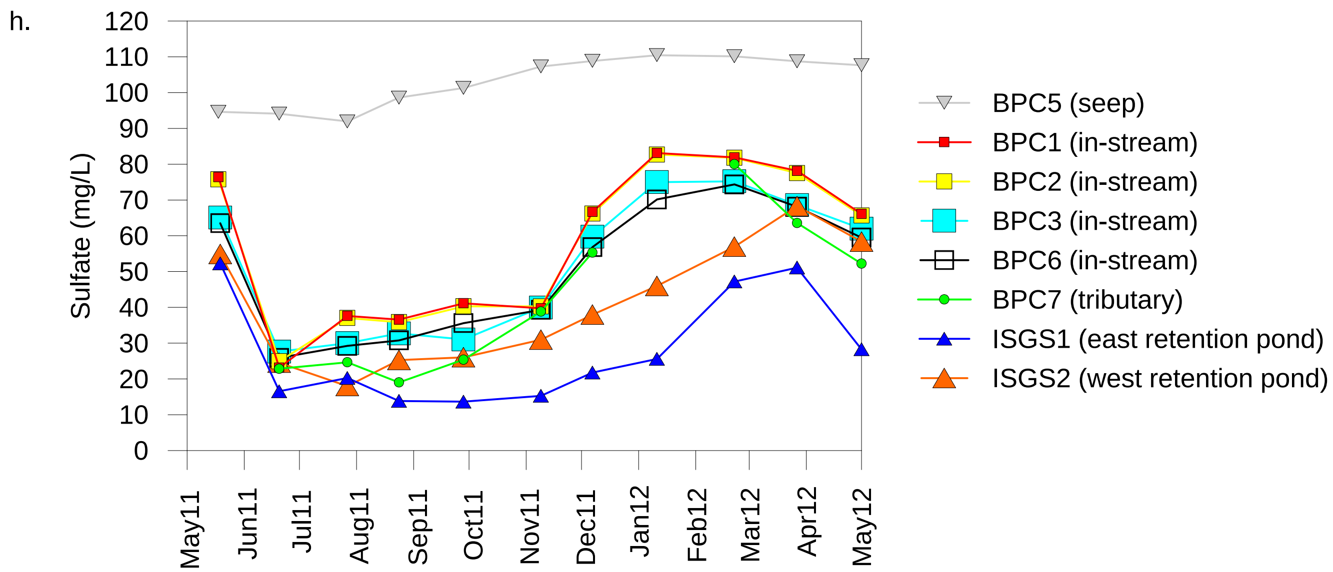


Figure 5 (continued). Concentrations of selected analytes measured in grab samples from the Black Partridge Creek watershed following construction of I-355.





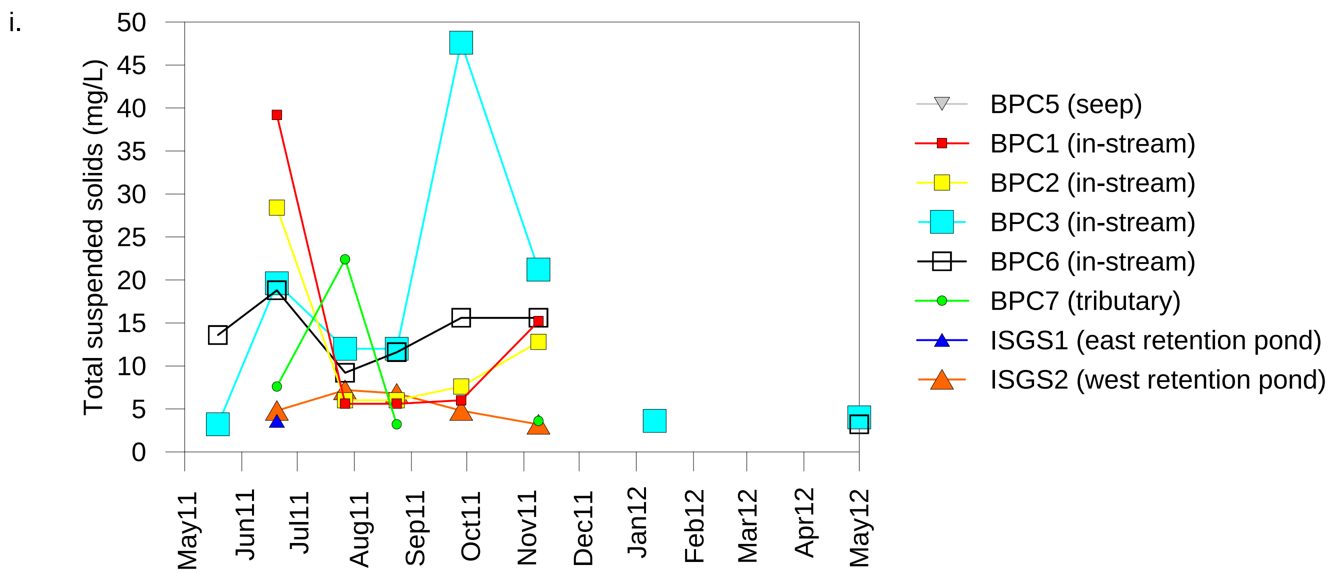
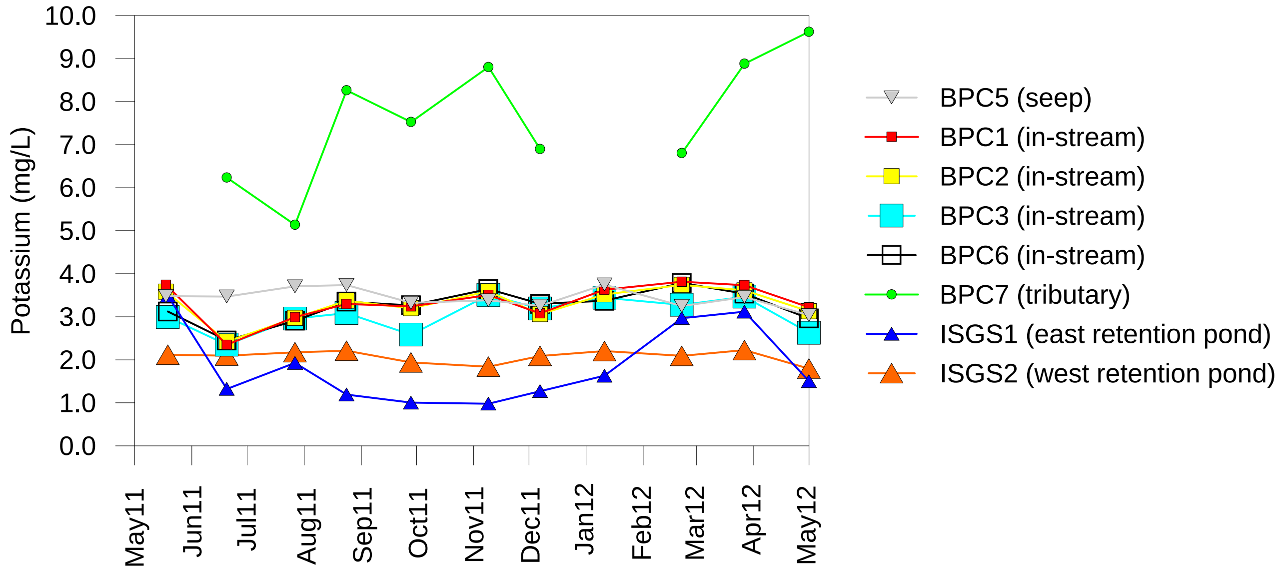
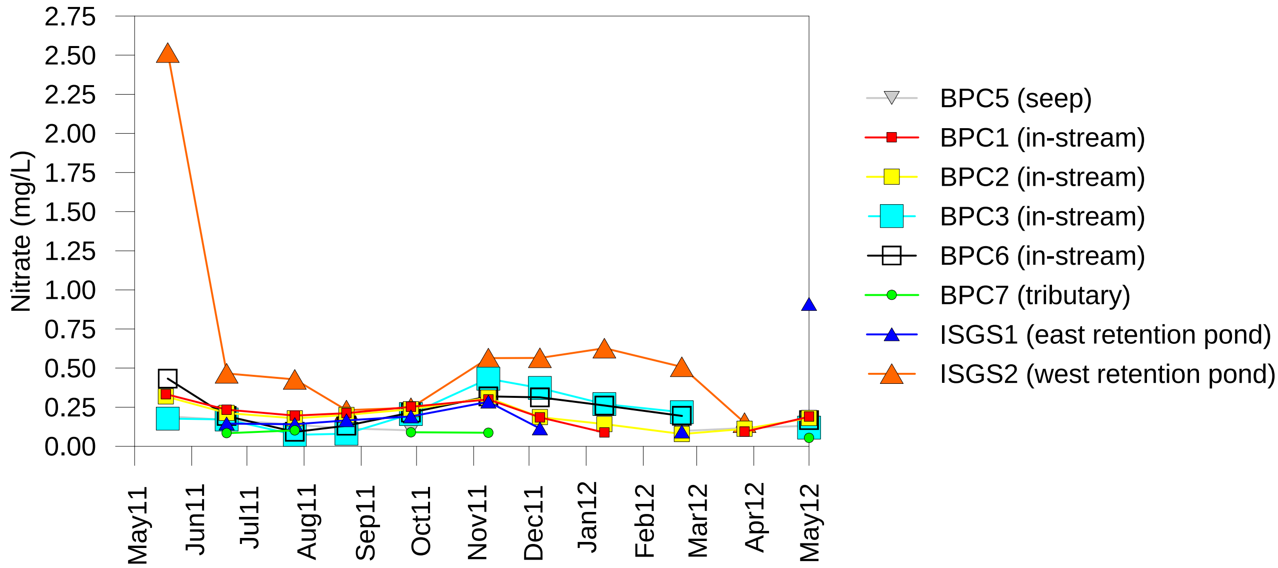


Figure 5 (continued). Concentrations of selected analytes measured in grab samples from the Black Partridge Creek watershed following construction of I-355.

j.



k.



l.

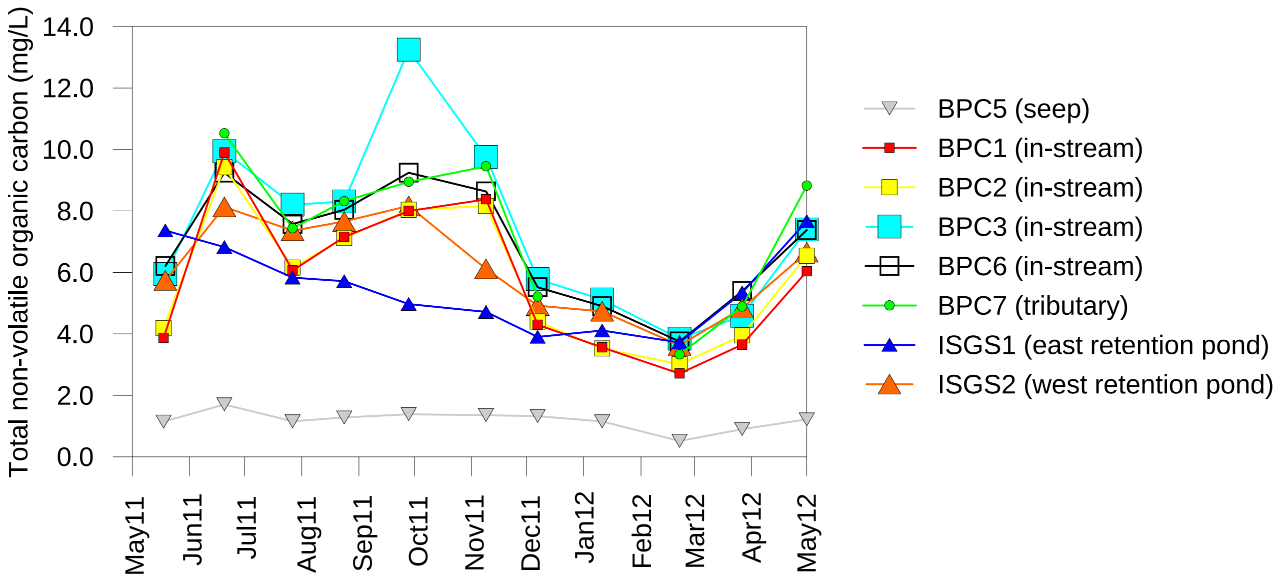
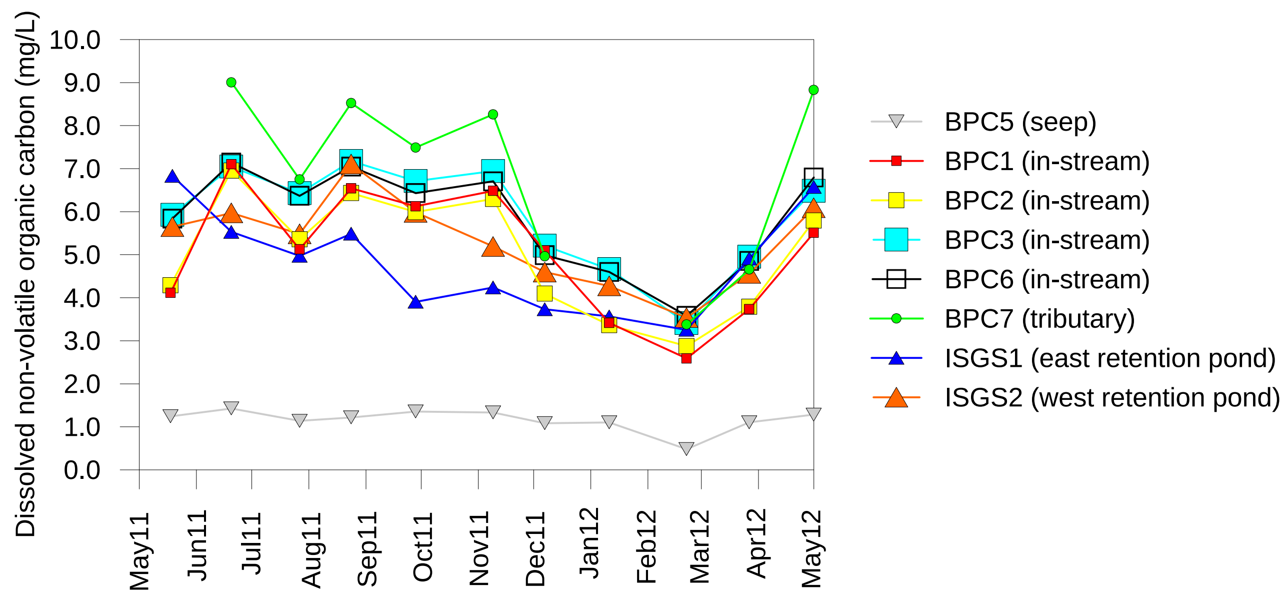
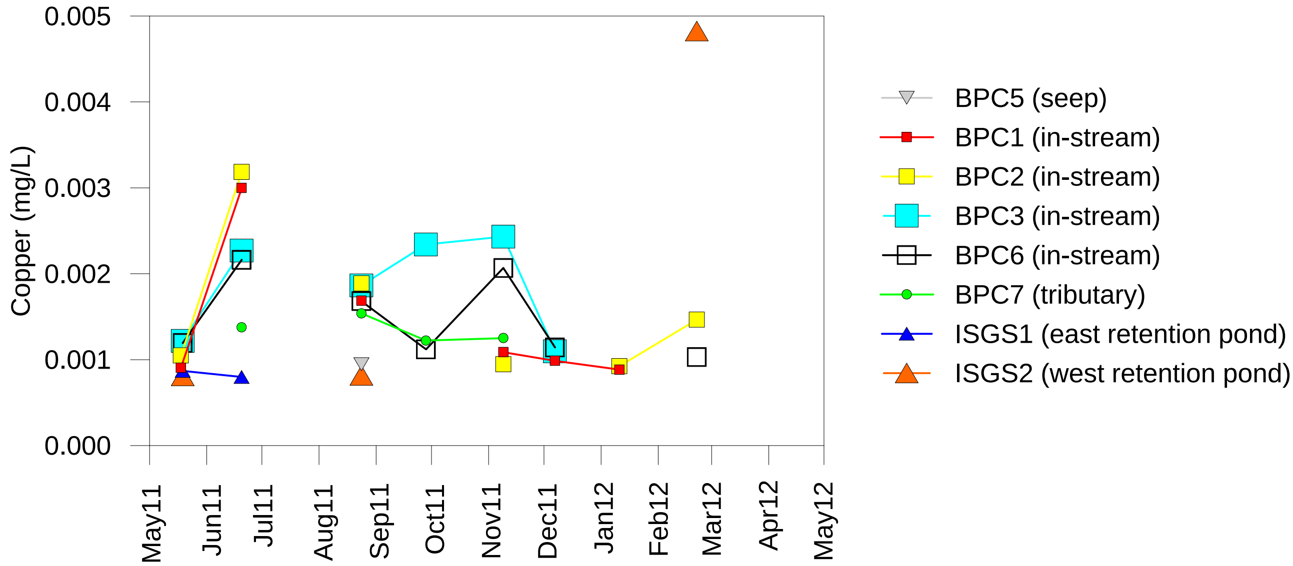


Figure 5 (continued). Concentrations of selected analytes measured in grab samples from the Black Partridge Creek watershed following construction of I-355.

m.



n.



o.

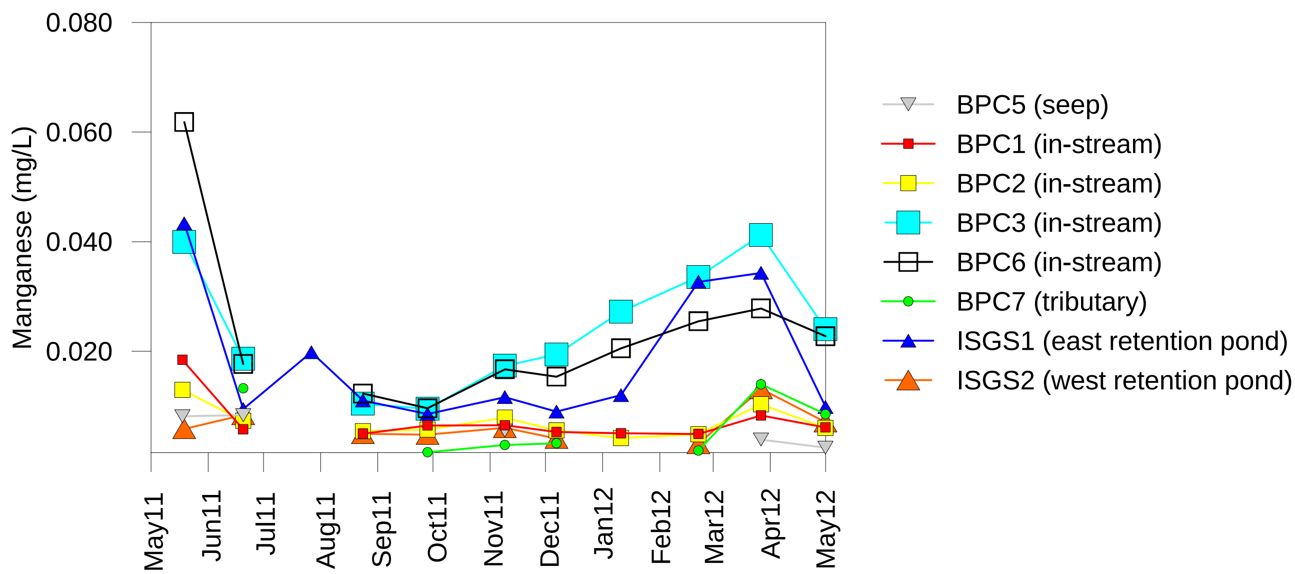


Figure 5 (continued). Concentrations of selected analytes measured in grab samples from the Black Partridge Creek watershed following construction of I-355.

Total Dissolved Solids

The highest maximum and mean TDS concentrations (1,896 mg/L and 956 mg/L, respectively) in post-construction surface-water grab samples were recorded in the I-355 tributary (BPC7), and the second highest maximum TDS value (1,789 mg/L) was measured from the east retention pond (ISGS1) (Table 1), suggesting that the developed upper reaches of the project area were contributing high-TDS runoff to the watershed. A distinct seasonal pattern in samples collected from the stream, the I-355 tributary, and the retention ponds shows TDS concentrations in these locations were greater than in the seep (BPC5) during winter and early spring (coincident with the roadway deicing season) and lower than in the seep during summer and fall (when road salt was not being applied and surface-water was diluted by higher seasonal rainfall amounts) (Figure 5a). In contrast, TDS concentrations in the seep showed relatively little variation throughout the year (range: 691-797 mg/L, average: 716 mg/L) (Figure 5a, Table 1).

Specific Conductivity

Specific conductivity is a measure of TDS. Miner et al. (2012a, 2012b) have shown in studies of runoff from Illinois tollways that specific conductivity levels increase in both surface-water and groundwater samples in response to wintertime deicing activities along roadways. During post-construction monitoring for this study, field measurements of specific conductivity were recorded at all sampling locations immediately prior to the collection of grab samples. Additionally, specific conductivity was measured every 4 hours by Hydrolab MS5 data loggers deployed in the stream at sampling locations BPC1 and BPC3, and at the overflow pipe for the west retention pond (ISGS2). Minimum and maximum levels, and calculated means and range of values of specific conductivity recorded by the data loggers and as field measurements are presented in Table 2. Field and data logger measurements of specific conductivity are presented graphically in Figure 6, along with daily precipitation totals measured at the Lewis University Airport weather station.

Field Measurements

The highest maximum and mean field measurements of specific conductivity (3,385 µS/cm and 1,767 µS/cm, respectively) were recorded in the I-355 tributary, while the second highest maximum field measurement (3,278 µS/cm) was recorded at the overflow pipe of the east retention pond (Table 2). The next highest mean values were recorded in the stream (range: 1,224-1,312 µS/cm, decreasing downstream from BPC6), followed by the seep (1,207 µS/cm), the east retention pond (1,206 µS/cm), and the west retention pond (817 µS/cm). Minimum, maximum, and mean specific conductivity measurements at BPC6 were greater than at BPC3, indicating high-conductivity water from the I-355 tributary was entering the stream between these two points throughout the year, as well as from the east retention pond during the winter and early spring when specific conductivity in the pond was significantly elevated with respect to the creek (Figure 6). Minimum, maximum, and mean specific conductivity values were slightly less at BPC1 than at BPC2, suggesting dilution either from increasing groundwater inputs to the creek or from precipitation-derived runoff from Bluff Road and the surrounding landscape. In any case, potential inputs from Bluff Road did not result in an observed increase in specific conductivity in the creek. Field measurements of specific conductivity follow the same general seasonal patterns (Figure 6) as observed in the grab sample results for TDS, sodium, and chloride (Figures 5a-c), suggesting it is a useful parameter for assessing impacts to surface-water from roadway deicing activities.

Table 2. Minimum, maximum, mean, and range of post-construction specific conductivity measured prior to sampling (field) and by ISGS data loggers.

Measurement location	Minimum	Maximum	Mean	Range
BPC1 (field)	693	2,178	1,224	1,485
BPC1 (logger)	265	4,038	1,334	3,773
BPC2 (field)	747	2,188	1,266	1,441
BPC3 (field)	352	2,264	1,236	1,912
BPC3 (logger)	143	4,950	1,302	4,807
BPC5 (field) - *seep*	1,171	1,235	1,207	64
BPC6 (field)	786	2,363	1,312	1,577
BPC7 (field) - *I-355 tributary*	899	3,385	1,767	2,486
ISGS1 (field) - *east retention pond*	298	3,278	1,206	2,980
ISGS2 (field) - *west retention pond*	288	1,718	817	1,430
ISGS2 (logger) - *west retention pond*	318	2,525	861	2,207

* All concentrations reported as µS/cm.

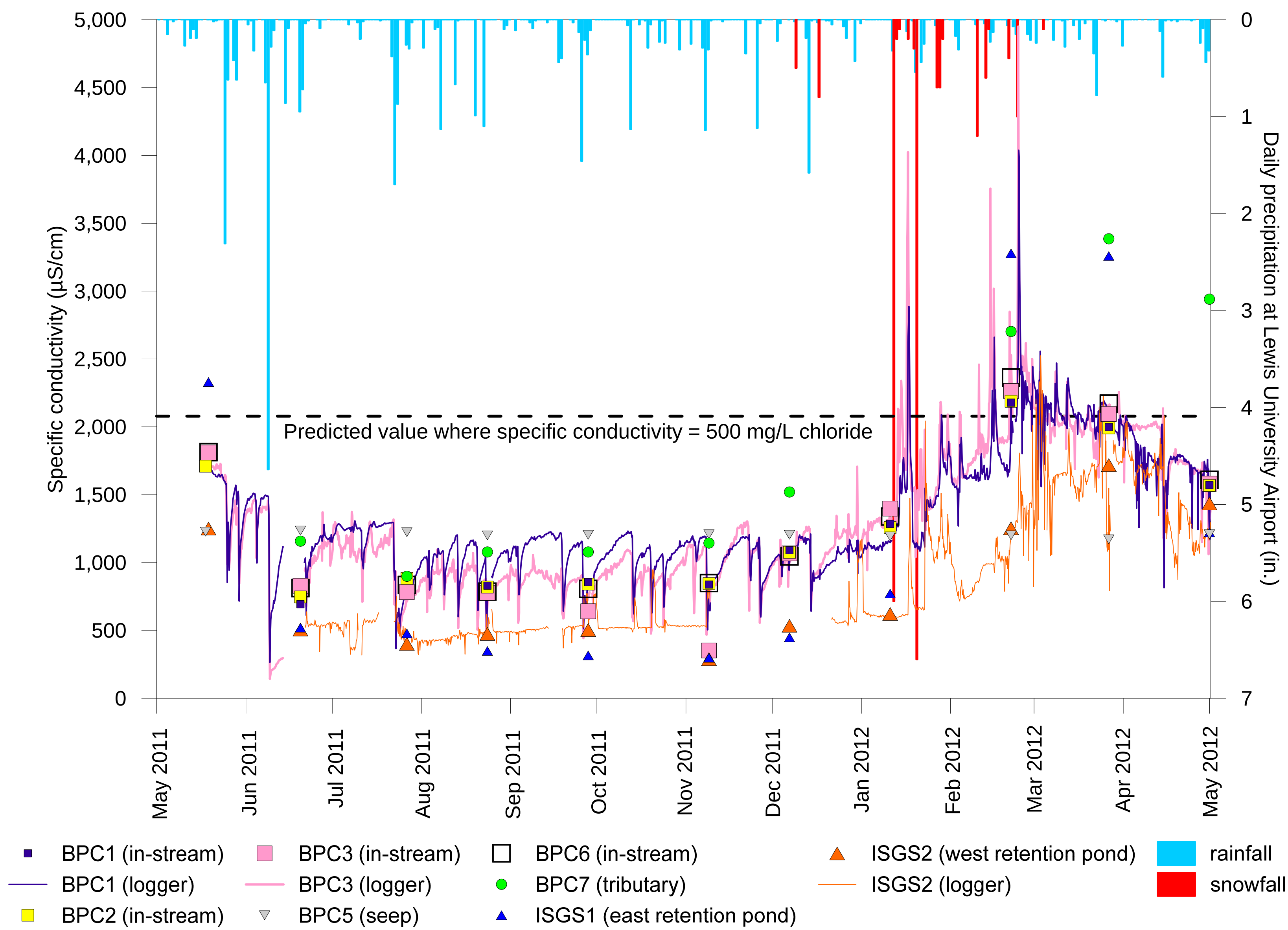


Figure 6. Specific conductivity measured in the Black Partridge Creek watershed following construction of I-355.

Data Logger Measurements

The following mean specific conductivity values were calculated for the 3 data loggers: BPC1 (1,334 µS/cm), BPC3 (1,302 µS/cm), the west retention pond (861 µS/cm) (Table 2). From June through mid-November 2011, specific conductivity measured by the downstream data logger at BPC1 was typically greater than that measured by the upstream data logger at BPC3, and the maximum values measured at BPC1 were similar to the field measurements recorded for the seep (Figure 6). This suggests that during the summer months, when precipitation and runoff started to decrease (Figure 3), groundwater made up a larger proportion of flow in the downstream reaches of the creek, resulting in the higher specific conductivity values measured at BPC1. Further up in the watershed, groundwater influence to the creek was assumed to be less, resulting in a higher proportion of flow derived from lower-conductivity surface-water runoff, presumably from the many retention basins that collect runoff from the numerous impervious surfaces in the developed northern reaches of the watershed. This was supported by the low specific conductivity values recorded by the data logger at the overflow of the west retention pond (Figure 6). Also during this period, rapid declines in specific conductivity at BPC1 and BPC3 were recorded by the data loggers during or immediately following rainfall events, as the water in the creek was quickly diluted by low-conductivity runoff. During these declines, specific conductivity levels at BPC3 were significantly diluted, dropping to approximately the same levels recorded at the west retention pond, while the declines at BPC1, though generally of comparable magnitude, did not drop as low, reflecting a higher proportion of groundwater contributing to flow in the lower reaches of the creek. Following each decline, specific conductivity at BPC1 and BPC3 gradually rebounded over a period of several days or weeks until they were depressed again by the next rainfall event.

Specific conductivity logged at the west retention pond during this period was generally more stable. Although small declines in concentrations occurred following rains, more prominent are the several upward spikes that are observed in the record from the data logger, most notably in late September through early November 2011. One possible explanation for these spikes in specific conductivity during the fall, when seasonal road salting has yet to begin, is that the Hydrolab at the overflow of the west retention pond was affected by high-conductivity water from the I-355 tributary, generated as a result of flushing of chloride stored in the soil and shallow groundwater from previous wintertime roadway salting events along Internationale Parkway and I-355. Field observations found that flow in the I-355 tributary was often very low to non-existent except following significant precipitation events, and on 9/28/11 and 11/9/11 the ISGS observed "heavy flow" from the I-355 tributary on those dates, coincident with the spikes in specific conductivity recorded by the ISGS2 data logger at those times.

Specific conductivity measured by the data loggers in the creek (BPC1 and BPC3) began to rise in early to mid-January 2012, peaked in mid-February, and began declining in March, while levels measured at the overflow of the west retention pond began increasing in mid-January, peaked in late March, and began decreasing by mid-April (Figure 6). Specific conductivity values likely increased in the wintertime both as a result of increased inputs (i.e. chloride and sodium ions dissolved from road salt) and decreased dilution in response to lower daily and monthly precipitation (Figures 3 and 4). The delay in the peak and decline of specific conductivity values measured at the overflow of the west retention pond, as compared to the records for BPC1 and BPC3, was likely due to the ability of the retention pond to attenuate the discharge of high-conductivity waters due to dilution, storage, and gradual release of the water via the overflow pipe.

Several large spikes in specific conductivity, with values ranging from about 2,500 to 5,000 µS/cm, were recorded at BPC1 and BPC3 following precipitation events in January through early March 2012 (Figure 6). These spikes likely represented flushing of deicing salts from roadways and parking lots during these events. Spikes recorded at BPC3 are up to 1,137 µS/cm larger than those recorded at BPC1, reflecting the proximity of BPC3 to the industrialized upper reaches of the main channel of Black Partridge Creek and I-55, and the subsequent dilution by groundwater inputs in the lower reaches of the stream.

Sodium and Chloride

On average, sodium and chloride together accounted for 71% and 65% of TDS measured in the I-355 tributary (BPC7) and the east retention pond (ISGS1), respectively, compared to 57-62% of TDS in the stream (decreasing downstream), 55% of TDS in the west retention pond (ISGS2), and 29% of TDS in the seep (BPC5). The highest minimum and mean concentrations of sodium (129 mg/L and 259 mg/L, respectively) and chloride (173 mg/L and 438 mg/L, respectively) and the second highest maximum values (518 mg/L and 951 mg/L, respectively) in grab samples were recorded in the I-355 tributary, while the highest maximum sodium (566 mg/L) and chloride (963 mg/L) concentrations were recorded in the east retention pond (Table 1). Additionally, chloride exceeded the Illinois Pollution Control Board's (IPCB) General Use Water Quality Standard (hereafter referred to as the General Use Standard) (Illinois Pollution Control Board, undated) for surface water (500 mg/L) in grab samples a total of 11 times at the following locations: BPC2 (once), BPC3 and BPC6 (twice each), I-355 tributary and east retention pond (3 times each) (Appendix B).

Spatial and seasonal trends in sodium and chloride were similar to those observed in TDS (Figures 5a, 5b, and 5c), suggesting halite (NaCl), commonly used to de-ice roadways, was the primary source of elevated levels of these two constituents. Furthermore, while TDS concentrations in the creek became dilute with respect to the seep in summer and fall, sodium and chloride concentrations in the creek generally remained higher than in the seep throughout the year, indicating that wintertime deicing activities in the upper reaches of the watershed were impacting water quality in Black Partridge Creek throughout the year. In May 2011 and again in February-May 2012, the concentrations of sodium, chloride, and TDS in the I-355 tributary and in the east retention pond were much higher than all other locations. Furthermore, all chloride exceedances of the General Use Standard for surface-water, measured in grab samples and discussed above, were from samples collected during the months of February, March, and May. These increases and exceedances provide strong evidence that impacts to the watershed from local deicing activities were being directed into Black Partridge Creek at these two locations, with additional evidence supporting this assertion provided in Photograph 4, which shows piles of excess road salt in the parking lot adjacent to the east retention pond (Figure 2). Lastly, minimum, maximum, and mean TDS, sodium, and chloride concentrations were higher at BPC6 than BPC3, indicating inputs from the I-355 tributary and the east retention pond were causing an increase of these analytes in the creek downstream of BPC3. By contrast, minimum, maximum, and mean TDS, sodium, and chloride concentrations at BPC1 and BPC2 were similar to each other suggesting limited impacts from Bluff Road (Table 1). Furthermore, TDS, sodium, and chloride concentrations at BPC1 and BPC2 were lower than those measured upstream at BPC6 (Table 1) suggesting dilution by groundwater and/or surface-water inputs having lower concentrations of these constituents in the downstream reaches of the creek.

Predicted Chloride Levels Using Specific Conductivity Data Loggers

Recent ISGS studies of urban streams and engineered bioswales in northeastern Illinois have predicted chloride concentrations in surface water and groundwater from data-logged specific conductivity measurements (Campbell et al. 2011, Miner et al. 2013). Following the method developed in Campbell et al. (2011), a model was created for this study by plotting post-construction chloride values from grab samples versus the associated field measurements of specific conductivity taken during collection of those grab samples (Figure 7). The resulting equation for predicting chloride levels along Black Partridge Creek is as follows:

Equation 1: $\text{chloride (mg/L)} = (\text{specific conductivity } [\mu\text{S/cm}] * 0.2864) - 95.4461$

Using this equation, when specific conductivity exceeded 2,079 ppm (µS/cm), chloride was predicted to exceed the General Use Standard for chloride in surface water, which is 500 mg/L.

Photograph 4. Piles of excess de-icing salt observed on March 28, 2012 in the parking lot immediately east of the eastern retention pond that flows into Black Partridge Creek at the ISGS1 sampling location. View oriented to the southeast, with the pond in the background.

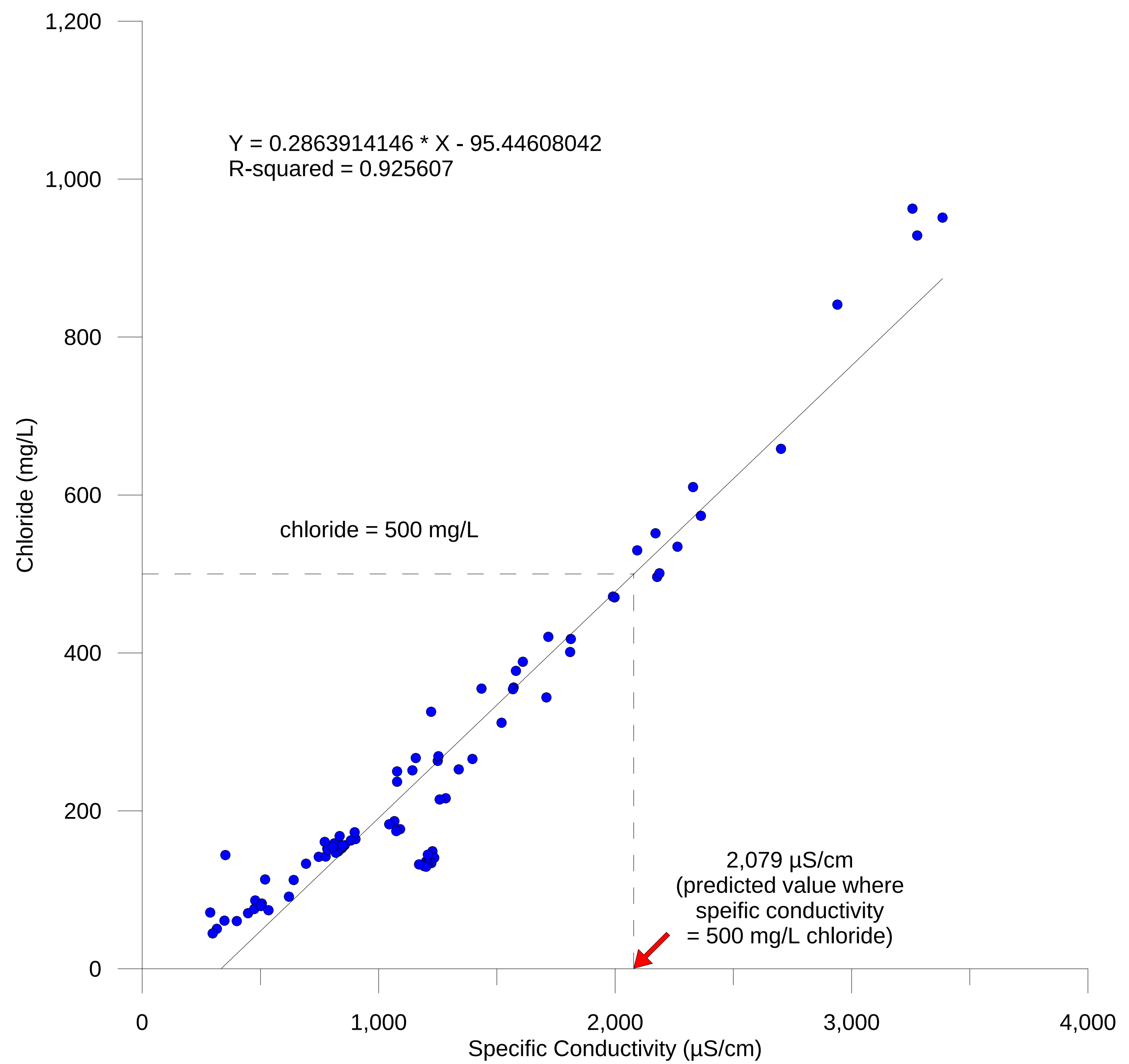


Figure 7. A plot of chloride versus specific conductivity used to predict chloride concentrations in the Black Partridge Creek watershed.

Therefore, according to measurements recorded by ISGS data loggers, the General Use Standard for chloride was met or exceeded at BPC1, BPC3, and the west retention pond (ISGS2) several times between January and April 2012 (Figure 6). No chloride exceedances were measured in grab samples collected from BPC1 or the west retention pond, demonstrating the utility of data loggers for documenting water quality between less frequent sampling events.

Calcium, Magnesium, and Alkalinity

Minimum, maximum, and mean concentrations of calcium (109 mg/L, 121 mg/L, 113 mg/L, respectively), magnesium (51 mg/L, 57 mg/L, 53 mg/L, respectively), and alkalinity (as $CaCO_3$) (337 mg/L, 343 mg/L, 341 mg/L, respectively) in post-construction samples were generally greatest in the seep (Table 1), reflecting its interaction with the dolomitic ($CaMg(CO_3)_2$) bedrock underlying the study area. In the creek, maximum and mean concentrations of these analytes generally increased downstream, likely as a result of increasing groundwater inputs to the creek. Calcium, magnesium, and alkalinity concentrations measured in the retention ponds were the lowest out of all samples, reflecting the storage of precipitation-derived surface-water runoff, which is dilute with respect to these constituents as a result of limited interaction with the underlying geologic materials.

Calcium, magnesium, and alkalinity concentrations in the watershed over time are presented in Figures 5d, 5e, and 5f, respectively. While concentrations of these constituents were relatively stable in the seep (BPC5) throughout the year, a seasonal pattern was observed in all other samples, with lower concentrations in summer and fall due to dilution from increased precipitation (Figure 3) and resultant surface-water runoff, and higher concentrations in winter and spring when rainfall and runoff were less and the groundwater component of flow in the creek was presumably greater. In samples collected in February and March 2012, calcium and magnesium concentrations in the I-355 tributary increased with respect to the other surface-water samples and more closely approximated concentrations measured in the seep (Figures 5d and 5e). At the same time, however, alkalinity measured in the I-355 tributary was still noticeably less than that observed in the seep (Figure 5f), suggesting that increased levels of calcium and magnesium could be trace-elements associated with rock salt applied as a deicing agent or other roadway runoff constituents. Miner et al. (2014) listed calcium as one of the primary constituents by mass found in highway runoff, and they also noted that grab samples for both calcium and magnesium showed seasonal patterns consistent with late winter/early spring loading and runoff. In either case, only small differences in concentrations of calcium and magnesium were observed between the two upstream locations (BPC3 and BPC6) and the two downstream locations (BPC1 and BPC2) indicating that neither the developed areas or I-355 to the north nor Bluff Road were having an appreciable impact to the creek with respect to these constituents (Table 1).

Sulfur and Sulfate

Minimum, maximum, and mean concentrations of sulfur and sulfate were greatest in the seep (sulfur: 33 mg/L, 40 mg/L, 36 mg/L, respectively; sulfate: 92 mg/L, 110 mg/L, 103 mg/L, respectively) throughout the post-construction monitoring period (Table 1), and concentrations of these constituents generally increased downstream, suggesting that the occurrence and concentration of these constituents in the grab samples was related to increasing groundwater inputs lower in the watershed. Mean concentrations of sulfur and sulfate were lower in the I-355 tributary than in the stream, and lower still in the two retention ponds, due to inputs of surface-water runoff that is dilute with respect to these constituents. These trends are generally similar to those observed for post-construction calcium, magnesium, and alkalinity. Likewise, only small differences in concentrations of sulfur and sulfate were observed between the two upstream locations (BPC3 and BPC6) and the two downstream locations (BPC1 and BPC2) indicating that neither the developed areas or I-355 to the north nor Bluff Road were having an appreciable impact to the creek with respect to these constituents (Table 1).

Sulfur and sulfate concentrations in the watershed over time are presented in Figures 5g and 5h, respectively. A strong seasonal pattern in concentrations of both constituents was observed in all samples except for the seep, and, if compared to monthly precipitation totals (Figure 3), it is apparent that concentrations were being diluted to a greater extent during the summer and fall months when precipitation was greater, and less dilution was occurring in the winter and spring months when precipitation was less. No spikes in concentrations of sulfur and sulfate are apparent in samples collected from the I-355 tributary and the retention ponds, suggesting that the developed areas in the northern part of the watershed were not contributing excessive amounts of these constituents to the creek. Rather, the lower mean concentrations of sulfur and sulfate in the I-355 tributary and the two retention ponds indicates that precipitation-driven runoff from the developed areas of the watershed was diluting these analytes with respect to their natural concentrations as observed in the seep.

Total Suspended Solids

The highest maximum and mean TSS concentrations (47.6 and 15 mg/L, respectively) recorded in grab samples were measured at BPC3 (Table 1). In general, TSS concentrations were highest in the creek, followed by the I-355 tributary, the retention ponds, and finally the seep. Figure 5i presents post-construction TSS concentrations measured in grab samples over time. Most TSS detections occurred in the summer and fall, likely due to higher precipitation and runoff amounts that would mobilize sediment in the creek. This is supported by daily rainfall data (Figure 4) that showed precipitation totaling one or more inches fell on or immediately before the June 20, July 27, August 24, September 28, and November 9 sampling dates in 2011. Few detections were made in samples collected during the winter and spring when precipitation in the days prior to sampling tended to be less, resulting in less sediment mobilization. Figure 5i shows the greatest number of TSS detections occurred in the upstream sample locations BPC3 and BPC6, presumably due to their proximity to runoff entering the creek from the highly-developed areas in the northern part of the watershed. Overall, TSS concentrations measured in grab samples show a great deal of variability, both in ranges of values measured at individual sample sites and in the relative concentrations between sites, suggesting that a monthly sampling interval was too coarse for further analysis of this parameter.

Turbidity

Turbidity was measured by Hydrolab MS5 data loggers every 4 hours at BPC1, BPC3, and ISGS2 (the west retention pond) (Figure 8). Factors that may contribute to increased turbidity include urban runoff, soil erosion (including eroding stream banks), excessive algal growth, and waste discharge, among others (U.S. Environmental Protection Agency 1997). Minimum and maximum turbidity measurements and calculated means and ranges of values recorded by ISGS data loggers are presented below in Table 3.

Table 3. Minimum, maximum, mean, and range of post-construction turbidity measured by ISGS data loggers.

Data logger location	Minimum	Maximum	Mean	Range
BPC1	0	2,830	16	2,830
BPC3	0	2,851	36	2,851
ISGS 2 (west retention pond)	0	1,401	21	1,401

* All concentrations reported as Nephelometric Turbidity Units (NTU).

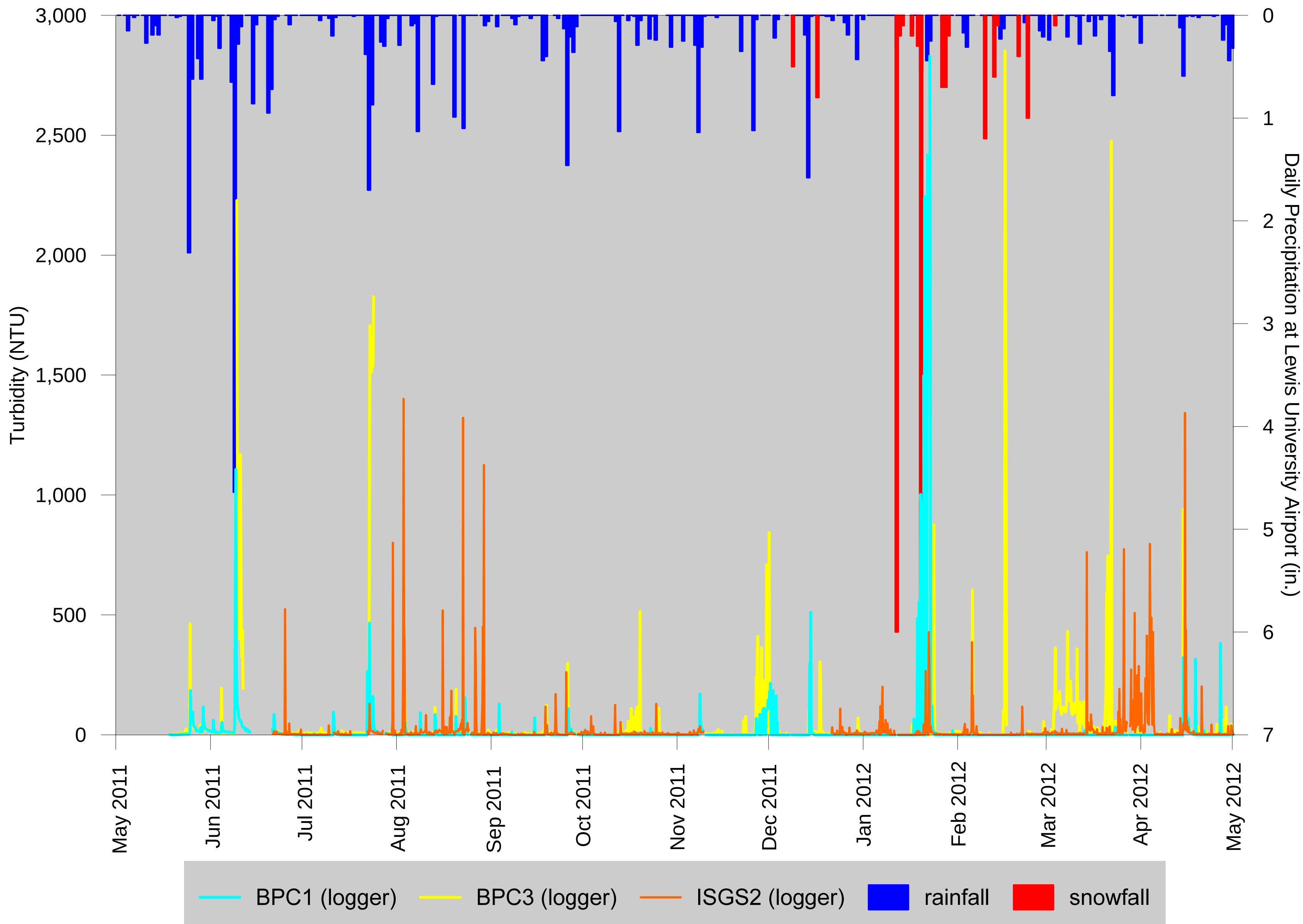


Figure 8. Turbidity measured by data loggers in the Black Partridge Creek watershed following construction of I-355.

Mean turbidity was highest at BPC3 (36 NTU), followed by ISGS2 (the west retention pond) (21 NTU), and BPC1 (16 NTU). Spikes in turbidity were strongly correlated to precipitation events recorded at the Lewis University Airport weather station (Figure 8), and presumably reflected entrainment of sediment and organic matter in the water column as surface-water runoff entered and flushed through the watershed. Figure 8 shows that turbidity levels recorded during any one event were generally higher at the upstream locations BPC3 and ISGS2 (the west retention pond) than at the downstream location BPC1. This may reflect the proximity of BPC3 and ISGS2 to the developed upper portion of the watershed, which presumably contributed a greater volume of runoff (and therefore entrained a greater amount of sediment and organic matter) from the numerous impervious surfaces in that area. Additionally, storage and attenuation of floods along the length of the creek likely allowed some of the larger and denser particles to settle out of the water column (thereby reducing turbidity) by the time water had reached BPC1. Seasonally, turbidity levels in the creek were highest in the winter and spring (when vegetation was dormant or dead, and erosion presumably occurred more easily) and tapered off during the summer and fall (when vegetation was growing and established, and erosion was less). Turbidity measurements recorded at the overflow for the west retention pond (ISGS2) were highest from late June through August 2011, and again from mid-January to April 2012, possibly during drier conditions in the pond, which might have allowed greater mobilization of sediment during storm events, though this was not verified. Spikes in turbidity measured at the west retention pond could also indicate the logger was influenced by flushes of turbid water from the I-355 tributary during high-flow events. Runoff, soil erosion, and excessive algal growth in the numerous retention ponds in the upper reaches of the watershed are considered to be the most likely contributors of turbidity to the Black Partridge Creek watershed.

Potassium

The greatest minimum, maximum, and mean concentrations of potassium (5.1 mg/L, 9.6 mg/L, and 7.6 mg/L, respectively) were measured in the I-355 tributary (Table 1). The next greatest mean concentration was calculated for the seep (3.4 mg/L), followed by the stream (3.0 to 3.3 mg/L, increasing downstream from BPC3), with the lowest levels measured in the retention ponds (1.9 to 2.1 mg/L).

Figure 5j shows potassium concentrations in the watershed over time, with potassium levels in the I-355 tributary clearly elevated with respect to all other samples. A seasonal trend in potassium levels was not clearly defined. The two highest potassium values in the I-355 tributary were measured in samples collected in March and May 2012, and the highest levels measured in the east retention pond came from samples collected in May 2011 and in February and March 2012, suggesting that potassium was primarily entering the watershed in winter and spring, possibly as a trace mineral associated with the application of road salt during roadway deicing activities. In contrast to other analytes that are believed to be associated with roadway deicing activities and whose concentrations decreased during the summer and fall months, potassium concentrations in the I-355 tributary remained elevated with respect to all other samples throughout the year. This suggests there was either an additional source of potassium in the watershed surrounding the I-355 tributary, or that potassium was not flushed from the I-355 tributary with the same efficiency as other roadway-derived constituents. Nearly identical minimum, maximum, and mean concentrations of potassium were recorded at BPC1 and BPC2, suggesting that runoff from Bluff Road did not have any measurable effect on potassium levels in the creek.

Nitrate

The highest minimum, maximum, and mean concentrations of nitrate (0.2 mg/L, 2.5 mg/L, and 0.6 mg/L, respectively) were measured in outflow from the west retention pond (ISGS2), while the second highest maximum and mean concentrations (0.9 mg/L and 0.3 mg/L, respectively) were measured in outflow from the east retention pond (ISGS1). Mean nitrate concentrations measured in the stream were lower (0.2 mg/L at all locations), and lowest in the seep and the I-355 tributary (0.1 mg/L at both locations).

Figure 5k presents nitrate concentrations in the watershed over time. Elevated nitrate levels observed in the west retention pond in May through July 2011 and again in November 2011 through February 2012, and in the east retention pond in May 2012 could be associated with seasonal applications of fertilizer to lawns in the developed northern reaches of the watershed during the spring and fall months. In May 2011, when the highest level was measured in the west retention pond, nitrate measured at BPC6 was greater than at BPC3, suggesting discharge from the west retention pond was causing an increase in nitrate levels in the creek at that time. Neither the I-355 tributary nor Bluff Road had any noticeable effect on nitrate levels in the creek.

Total and Dissolved Non-Volatile Organic Carbon

The greatest minimum, maximum, and mean concentrations of total non-volatile organic carbon (tNVOC) (3.8 mg/L, 13.3 mg/L, and 7.5 mg/L, respectively) were measured in samples from BPC3, while the next highest maximum and mean levels (10.5 mg/L and 7.4 mg/L, respectively) were measured in the I-355 tributary (Table 1). Conversely, the highest maximum and mean levels of dissolved non-volatile organic carbon (dNVOC) (9.0 mg/L and 6.9 mg/L, respectively) were measured in the I-355 tributary, and the second highest maximum and mean concentrations (7.2 mg/L and 5.9 mg/L, respectively) were recorded at BPC3. Mean concentrations of tNVOC and dNVOC generally decreased downstream, and the lowest minimum, maximum, and mean concentrations of these constituents were recorded in the seep. Mean concentrations measured in the west retention pond were similar to in-stream levels, while mean concentrations in the east retention pond were lowest other than in the seep. The higher levels of NVOCs observed at BPC3 and the I-355 tributary suggests organic matter was entering the creek in the upper reaches of the watershed, likely as a result of flushing of organic matter from retention ponds and cattail marshes during rainfall events. Miner et al. (2014) commonly found total and dissolved non-volatile organic carbon as constituents in roadway runoff, so it is also possible that runoff from I-355, Internationale Parkway, and I-55 might account for some of the higher concentrations of NVOCs measured in the I-355 tributary and at BPC3 (Figure 5m). The decrease in NVOCs toward the bottom of the watershed suggested dilution by increased groundwater inputs, which were low in NVOCs (as indicated at the seep), as well as settling out and uptake by biota of some of the organic matter as it flowed through the watershed. Only slight differences were measured in dNVOC and tNVOC at BPC1 and BPC2, suggesting Bluff Road had no appreciable impact on the creek with respect to these analytes.

Figures 5l and 5m show concentrations of tNVOC and dNOVC, respectively, in the watershed over time. The lowest concentrations were measured during the winter and early spring months, and higher concentrations were measured from late spring through fall. This seasonality is likely due to a combination of the availability of more organic matter and higher rates of decomposition of this matter during the warmer summer and fall months in conjunction with greater mobilization of this matter as a result of increased precipitation during these months.

Roadway Metals

Metals commonly found in roadway runoff and also in urban streams include cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc (Herrera 2007, Paul and Meyer 2008, and Miner et al. 2014). These metals accumulate on roadways and parking lots from non-point sources (NPS) such as engine parts, tires, and brake linings on automobiles and trucks (Paul and Meyer 2008). Of these metals, only copper (35 instances), lead (1 instance), manganese (72 instances), and zinc (1 instance) were detected in dissolved form in the 86 post-construction samples collected from the Black Partridge Creek watershed. The maximum concentrations of copper, lead, and zinc that were detected in post-construction samples were all less than 10 times the detection limits of these constituents, making the results non-optimal for detailed analysis. Because lead and zinc were detected in only one sample each , only the lab results of copper and manganese are discussed below.

Copper

In post-construction samples, copper was detected most frequently in the I-355 tributary (67% of samples), followed by BPC6 (64%), BPC1, BPC2, and BPC3 (55% each), the west retention pond (27%), the east retention pond (18%), and finally the seep (9%) (Appendix B). The highest maximum and mean copper concentrations were measured in the west retention pond (0.0048 and 0.0021 mg/L, respectively), and the next highest mean concentration of copper was measured at BPC3 (0.0019 mg/L) (Table 1). Mean copper measured in the I-355 tributary and the remaining sampling locations in the stream were relatively similar, ranging from 0.0014 to 0.0016 mg/L, and mean copper was lowest in the seep (0.0010 mg/L) and the east retention pond (0.0008 mg/L).

Figure 5n presents post-construction copper concentrations measured in the watershed over time. Copper was most frequently detected between May and November 2011, during or immediately following significant rainfall events during the wetter summer and fall months, possibly due to mobilization of sediment to which copper is frequently bound. Specifically, precipitation totaling one or more inches fell on or immediately before ISGS sampling trips on June 20, August 24, September 28, and November 9, 2011. Both the number of detections and the concentrations of copper on these days tended to be higher than as seen on other days that were not preceded by heavy precipitation. In general, copper concentrations decreased downstream from BPC3 to BPC6, and also from BPC2 to BPC1, due likely to a combination of dilution by increasing groundwater inputs and adsorption of copper onto sediment, with settling out of this sediment from the water column. While copper was detected in 4 of 9 post-construction samples collected from the I-355 tributary, it is not apparent from the data that it was having any notable affect on water quality in Black Partridge Creek. Not including the seep, the fewest detections and generally the lowest concentrations of copper were made in the two retention ponds, likely due to their ability to promote sedimentation, thereby acting as a sink for copper and other heavy metals bound to sediment. It is not known what would cause the high reading of copper in the west retention pond on February 22, 2012.

Manganese

In post-construction samples, mean manganese concentrations were greatest at BPC3 and BPC6 (0.024 mg/L and 0.023 mg/L, respectively) and decreased downstream, presumably due to dilution by increased groundwater contributions. Manganese was detected most frequently in the east retention pond (100% of samples), followed by the stream (91%), the west retention pond (82%), the I-355 tributary (78%), and finally the seep (45%).

Post-construction manganese concentrations measured in the watershed over time are shown in Figure 5o. Seasonally, manganese concentrations were depressed in the summer and fall months and became elevated beginning in the winter and lasting through spring. This seasonal trend is likely the result of manganese in the soil becoming soluble and thus mobile as a result of reducing conditions that occur when soils are saturated, which generally occurs in the winter and spring, when temperatures are lower, plants are dead or dormant, and evaporation and transpiration rates are relatively low. Manganese concentrations were higher at the upstream locations (BPC3 and BPC6), possibly due to their proximity to cattail marshes and retention ponds in the upper reaches of the watershed, which, because they hold water for extended periods of time, might serve as sources for reduced manganese in the watershed. High manganese levels were measured in the east retention pond, but not in the west retention pond, but the reasons for this are unclear. Manganese was also detected in the I-355 tributary, but at concentrations approximating those observed downstream at BPC1 and BPC2, and also in the west retention pond. Therefore, the I-355 tributary did not appear to have any appreciable affect on manganese concentrations within the creek.

COMPARISON OF ISGS GRAB SAMPLES TO WATER-QUALITY STANDARDS

The results from ISGS grab samples were compared to Illinois General Use Water Quality Standards (Subpart B: General Use Water Quality Standards, Section 302.208, Numeric Standards for Chemical Constituents) (Illinois Pollution Control Board, undated) to determine if measured levels exceeded standards. Numeric standards for certain analytes are set at a given value (e.g., chloride at 500 mg/L), while the standards for other analytes must be calculated individually using equations that take into account other sample parameters that affect toxicity, such as hardness, which is calculated based on the calcium and magnesium content of the sample. Constituents evaluated against these standards for this report include pH, arsenic, cadmium, chloride, chromium, copper, iron, lead, manganese, nickel, sulfate, and zinc. Of these, only chloride, with a set standard of 500 mg/L, was found to exceed the general use water quality standard for surface water, as described previously.

BLANK AND DUPLICATE SAMPLES

Blank and duplicate grab samples were collected during each post-construction sampling trip as part of a quality assurance/quality control (QA/QC) program. A total of 11 duplicate samples were collected, with 40 analytes analyzed for each sample, for a total of 440 analytes (Appendix C). Only 9 individual analytes were detected with a greater than 20% percent difference between the original and the duplicate sample, with such differences observed in copper, ortho-phosphate, and fluoride (one occurrence each), iron (two occurrences), and phosphorous (four occurrences). Phosphorous values were determined via inductively coupled plasma spectroscopy (ICP) using USEPA Method 200.7, which can produce unreliable results for this analyte (Miner 2012b), and therefore the phosphorous results are discounted wholly and are not utilized in this report. The remaining analytes were measured at concentrations that were less than 10 times the detection limit in both the original and duplicate samples, which is considered non-optimal for analysis and is typical of when larger percent differences occur between the original and duplicate samples (Miner et al. 2014). Therefore these results do not suggest laboratory issues or needed adjustments to the data or methods. The overall mean relative percent difference between original and duplicate samples for all post-construction samples, excluding non-detections and phosphorous, was calculated to be 2.7% (Appendix C), which suggests reliable laboratory methods and results.

A total of 11 blank samples (Appendix D) were submitted to the laboratory to determine if field methods affected the levels of analytes reported. Blanks were composed of deionized water that was sampled using the same equipment and methods used to collect all other surface-water grab samples. Not including pH, a total of 43 detections were made in 440 analytes (11 samples x 40 analytes each) analyzed. Each of the 11 samples had between 2 and 6 analytes detected, with an average of 4 analytes detected per sample. The following analytes were detected most often, listed in decreasing number of detections: calcium (11), dissolved nonvolatile organic carbon (9), nonvolatile organic carbon (8), phosphorous and strontium (4 each), boron and magnesium (2 each), and sodium, ortho-phosphate, and ammonia (1 each). The highest level detected in the blanks was 1.89 mg/L of nonvolatile organic carbon, and only dissolved nonvolatile organic carbon had detections that exceeded 1 mg/L. Excluding pH and non-detections, the mean of all means detected for all analytes is 0.24 mg/L. Calcium was detected in all 11 blank samples, but at levels less than 0.5 mg/L. Given the blanks were made from deionized water and the source is a calcium bicarbonate tap water, the presence of low levels of calcium, magnesium, and strontium in the blanks is unsurprising. Similarly, filters can contribute organic carbon, sodium, and chloride, which are highly mobile ions that often are detected in blanks. Finally, no roadway metals of interest were detected in the blanks, and these results suggest that no alterations to field techniques were required, and that no samples should be removed from analysis.

COMPARISON OF PRE- AND POST-CONSTRUCTION GRAB SAMPLES

ISGS samples collected following construction of I-355 were compared to samples collected by the INHS prior to construction with the goal of determining if there were significant changes in the water chemistry in Black Partridge Creek as a result of the construction of the tollway. Full analytical results of the pre-construction grab samples, collected monthly by the INHS between March 1994 and September 2002 (Soluk et al. 2003), are reproduced in Appendix E, including the number of samples analyzed, the number and percentage of detections recorded for each analyte, and minimum, maximum, and mean concentrations. A table comparing pre- and post-construction geochemical results for a selected suite of analytes is provided in Appendix F, including percent changes calculated for minimum, maximum, and mean values. Sample locations visited by the INHS before construction represent the same general locations where post-construction samples were collected by the ISGS, with BPC1, BPC2, BPC3, and BPC6 representing in-stream samples, BPC5 representing the seep, and BPC7 representing the I-355 tributary. The east and west retention ponds (ISGS1 and ISGS2) are presented on graphs in this section for illustrative purposes only, and are not discussed since they were not sampled during the pre-construction study.

Several factors were taken into consideration during analysis of the samples collected before and after the construction of I-355, including gaps in the INHS data, changes in the method detection limits (MDLs) of certain analytes, the difference in size of the two sample populations, differences in the sampling procedures used by the INHS before construction and the ISGS after construction, and differences in sampling locations.

The INHS started collecting samples in the Black Partridge Creek watershed in March 1994, though sampling at BPC6 and the I-355 tributary (BPC7) did not start until November 1995, as reflected in Appendix E. Furthermore, gaps are present in the pre-construction records of all sampling sites, with the greatest number occurring in the data set for the I-355 tributary (BPC7). Gaps spanning several months, or even several seasons (as observed in the pre-construction records for the I-355 tributary) can complicate analysis of both spatial and temporal trends in data.

MDLs reported for chemical analysis may change over time, generally in response to analytical equipment or methods becoming more sensitive, thus leading to a decrease in the MDL, though increases in MDLs may also occur. Changes in the MDLs for certain analytes occurred both during the pre-construction phase and also between the pre-construction and post-construction phases of this project. A decrease in a MDL may result in a greater number of detections of a particular analyte at lower concentrations than were possible when the MDL was higher, thus biasing the data toward lower concentrations following the decrease in the MDL. Conversely, an increase in a MDL may preclude detections in subsequent samples that might otherwise have been detected at the previous lower MDL, thus biasing the data toward higher concentrations and fewer detections following the increase in the MDL.

The INHS collected between 43 and 89 samples from each sampling location before construction of I-355, while the ISGS collected between 9 and 11 samples from each location following construction. Mean concentrations for selected analytes in pre- and post-construction sample populations were calculated from detections only, and were compared to look for differences. However, since the number of pre-construction samples was much larger than the number of post-construction samples, a two-tailed Student's t-test assuming unequal variances was utilized to determine if differences between the means of each analyte in the two populations were significant. The full results of this statistical treatment of the data for selected analytes are presented in Appendix G, and a summary table is presented in Table 4.

The primary analytes discussed in this report were detected at the following percentages in pre- and post-construction samples: TDS, sodium, chloride, magnesium, alkalinity, sulfate (100%); potassium (70-100%); nitrate (56-100%); copper (9-64%); manganese (45-91%). More

Table 4. Changes in mean concentrations of selected analytes measured before and after construction of I-355.

Sample location		Total Dissolved Solids	Sodium	Chloride	Calcium	Magnesium	Alkalinity	Sulfate	Potassium	Nitrate	Manganese
Seep											
BPC5	percent change mean	-2	**8**	2	**6**	1	**11**	2	5	**-69**	-44
I-355 tributary											
BPC7	percent change mean	42	**231**	**196**	-29	**-37**	**-30**	**-53**	**119**	**-95**	-75
In-stream (upstream to downstream)											
BPC3	percent change mean	-16	10	-1	**-28**	**-33**	-15	**-34**	**-11**	**-83**	-54
BPC6	percent change mean	-8	33	19	**-27**	**-33**	**-16**	**-36**	**-16**	**-82**	-29
BPC2	percent change mean	-8	36	23	**-26**	**-31**	**-18**	**-35**	-4	**-83**	-49
BPC1	percent change mean	-5	44	30	**-25**	**-31**	**-19**	**-35**	-0.3	**-81**	-59

percent increase **statistically significant percent increases**
percent decrease **statistically significant percent decreases**

sophisticated statistical methods exist for dealing with non-detects in data, and these methods may have provided more meaningful results for analytes having fewer detections (i.e. nitrate, copper, and manganese), but this was beyond the scope of this report.

Different sampling methods were employed by the INHS and the ISGS, and require consideration when comparing the concentrations of metals reported for the pre- and post-construction phases of this study. According to Soluk et al. (2003) whole-water samples were collected by the INHS for transport to the lab, where the samples were then filtered and prepared (acidified) for dissolved metals analysis. This method allows the sample water to remain in contact with any suspended sediment that happens to be collected with the sample. If metals happen to be bound to those sediments, given enough time, some of them may go back into solution due to changes in pH, temperature, or for other reasons. This could potentially result in higher concentrations of certain metals in water samples collected using this method, versus samples where the water is filtered from the sediment at the time the sample is collected, as was done by the ISGS during the post-construction monitoring phase of this study.

Miner et al. (2014) calculated that in tollway runoff the average percentage of the total mass of copper carried in the non-dissolved form (i.e. adsorbed to sediment) was 65%. Applying the same methodology to sampling results reported in Miner et al. (2014) for calcium, magnesium, potassium, sodium, and manganese, the following average percentages of the total masses carried in the non-dissolved form were calculated: calcium (29%), magnesium (42%), potassium (19%), sodium (<1%), manganese (86%). These results suggest that detections and concentrations of metals such as copper, magnesium, and manganese, and to a lesser extent calcium and potassium, might be higher in samples drawn from water having had extended contact with sediment from which these metals might be bound.

During the post-construction phase of this study, the ISGS took great care to collect grab samples from the same approximate locations visited previously by the INHS, as documented in Soluk et al. 2003. However, during analysis of these samples, it was observed that certain analytes measured in the seep (BPC5) had much larger ranges of values in pre-construction data as compared to post-construction data. For example, sodium concentrations measured in post-construction samples ranged from 64-81 mg/L (mean of 73 mg/L), while sodium concentrations in pre-construction samples were much more variable, and ranged from 35-191 mg/L (mean of 68 mg/L) (Appendix F). The broad range of sodium values in pre-construction data at BPC5 suggests that the ISGS sampled a location different in the seep than that sampled by the INHS. The narrow range in post-construction data reflects the ISGS collecting samples from where the seep issued from the base of the bluff, before any mixing with surface water could occur. The large range of values in the pre-construction data suggest the INHS sampled a location that was more able to mix with surface-water inputs. Therefore, care was taken in interpreting the comparison of results involving samples collected from the seep. If any of the above factors is believed to have influenced analysis of a particular analyte, it is discussed in the following writeup for that analyte.

Total Dissolved Solids, Sodium, and Chloride

TDS, sodium, and chloride were detected in all pre- and post-construction samples (Appendix F). As compared to pre-construction samples, mean TDS increased in the I-355 tributary only (+42%), and decreased slightly at all other locations. Mean sodium increased at all locations, with the greatest percent increase (+231%) measured in the I-355 tributary, and mean chloride increased at all locations except BPC3, with the greatest percent increase (+196%) measured in the I-355 tributary. Minimum concentrations of post-construction TDS, sodium, and chloride increased at all sample locations, with the greatest percent changes (+94%, +2,310%, +1,689%, respectively) measured in the I-355 tributary. The only increases in maximum concentrations of post-construction sodium and chloride were measured in the I-355 tributary, with percentage increases of +15% and +7%, respectively. Of the increases in means noted above, the only statistically significant changes include the increases observed in mean sodium in the seep and the I-355 tributary, and the increase in mean chloride in the I-355 tributary (Appendix G, Table 4).

Pre- and post-construction TDS, sodium, and chloride concentrations are plotted versus monthly snowfall totals in Figures 9, 10, and 11, respectively. Seasonal variations in TDS, sodium, and chloride concentrations were observed in both pre- and post-construction results, with values peaking in the winter and spring months, presumably as a consequence of deicing activities following snow events, and generally decreasing in the summer and fall as a result of reduced inputs (i.e. no deicing) and dilution of runoff from increased precipitation. Post-construction concentrations of these analytes were generally within the range of values measured in pre-construction samples, except on March 27, 2012, when chloride and sodium exceeded maximum pre-construction values in the I-355 tributary, and on May 1, 2012, when sodium again exceeded maximum pre-construction values in the I-355 tributary.

High concentrations of TDS, sodium, and chloride (as compared to the seep) were measured in pre-construction samples from main channel of the creek (BPC1, BPC2, and BPC3) as early as 1994 (Figures 9, 10, 11), indicating water quality in Black Partridge Creek was being impacted with respect to these three constituents prior to the construction of I-355. The most likely source of the early impacts observed at BPC3 is from wintertime deicing activities along I-55, South Frontage Road, or Woodward Avenue (Figure 1), the only roadways intersecting and adjacent to the creek at that time as determined by a review of historical aerial photographs using Google Earth (Google, Inc. 2010). High concentrations of sodium and chloride were also observed in the I-355 tributary as early as the winter of 1995-‘96, when sampling began at that location. Historical aerial photographs (Google, Inc. 2010), showed that Internationale Parkway was constructed sometime between April 1993 and April 1998, making it the first roadway to intersect the I-355 tributary, and thus the most probable source (as a result of wintertime deicing activities) of increased sodium and chloride in the I-355 tributary at that time.

TDS, sodium, and chloride concentrations in pre-construction samples collected from the stream were generally highest at BPC3 and decreased downstream, suggesting water quality in the stream was being impacted by runoff from development in the upper reaches of the watershed. In grab samples collected from the I-355 tributary, pre-construction concentrations of sodium and chloride varied from very low to very high over time, while in post-construction samples, concentrations in the I-355 tributary were generally higher than at any other location, expect occasionally at the east retention pond. This may indicate an overall general increase in concentrations of these analytes in the I-355 tributary due to construction of I-355, but could also be a reflection of numerous gaps in the pre-construction data collected from the I-355 tributary.

Calcium, Magnesium, and Alkalinity

Calcium, magnesium, and alkalinity were detected in all pre- and post-construction samples (Appendix F), and concentrations of these analytes are plotted through time in Figures 12, 13, and 14, respectively. As compared to pre-construction data, decreases were observed in maximum and mean calcium, magnesium, and alkalinity in post-construction samples from all sampling locations in the creek (BPC1, BPC2, BPC3, and BPC6) and the I-355 tributary (BPC7), with the greatest percent decreases in mean concentrations of calcium, magnesium, and alkalinity recorded in the I-355 tributary (-29%, -37%, and -30%, respectively) (Appendix F). The decreases observed in the means of these analytes were determined to be statistically significant at each of these locations except for the following: I-355 tributary (calcium) and BPC3 (alkalinity) (Appendix G, Table 4). However, with respect to calcium and magnesium, these apparent decreases may be at least partially due to differences in sampling methods described at the beginning of this section, that could have resulted in higher concentrations of these metals in the pre-construction samples.

A general decrease in concentrations of calcium, magnesium, and alkalinity is seen over time in the

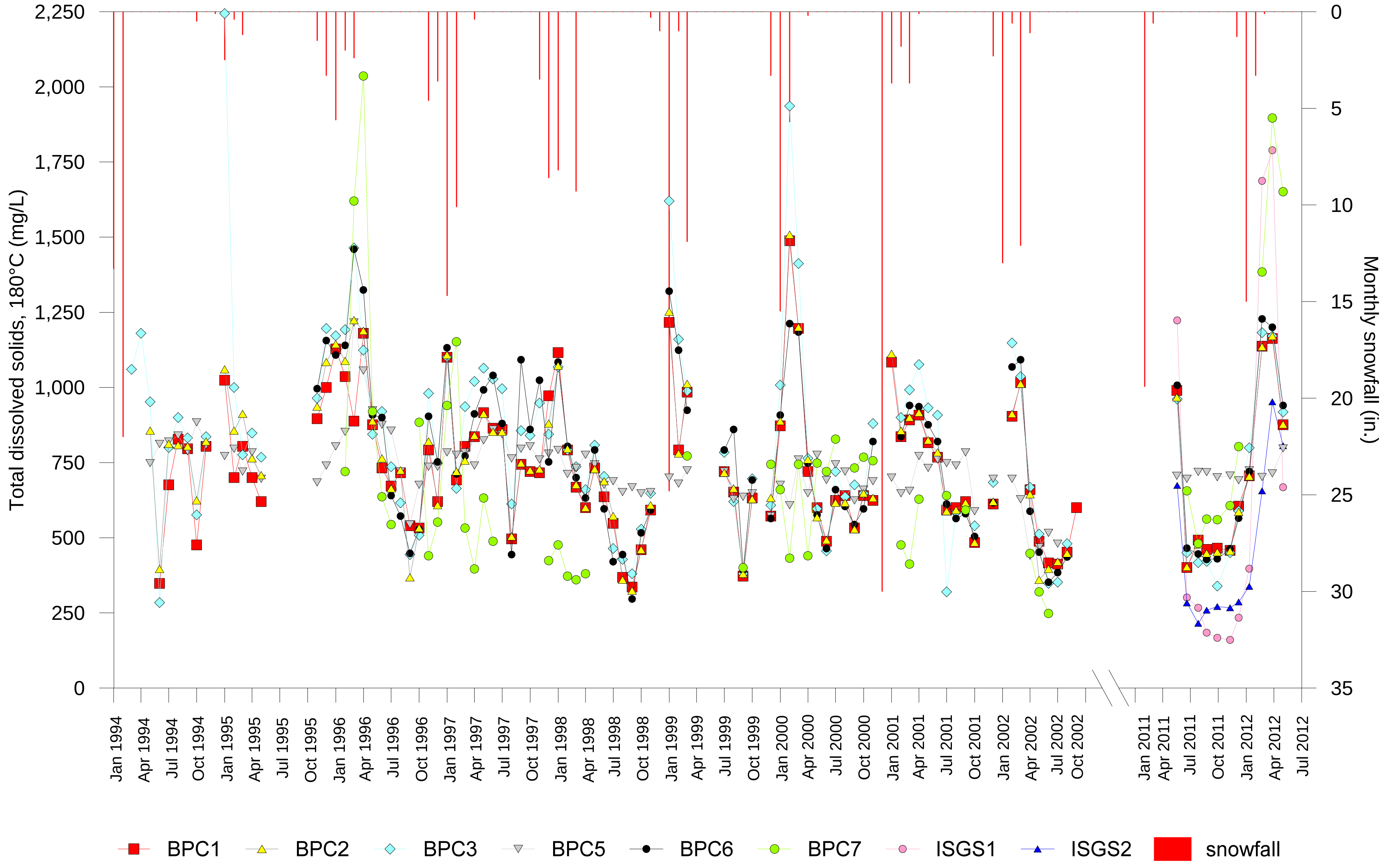


Figure 9. Comparison of TDS in grab samples collected before and after construction of I-355.

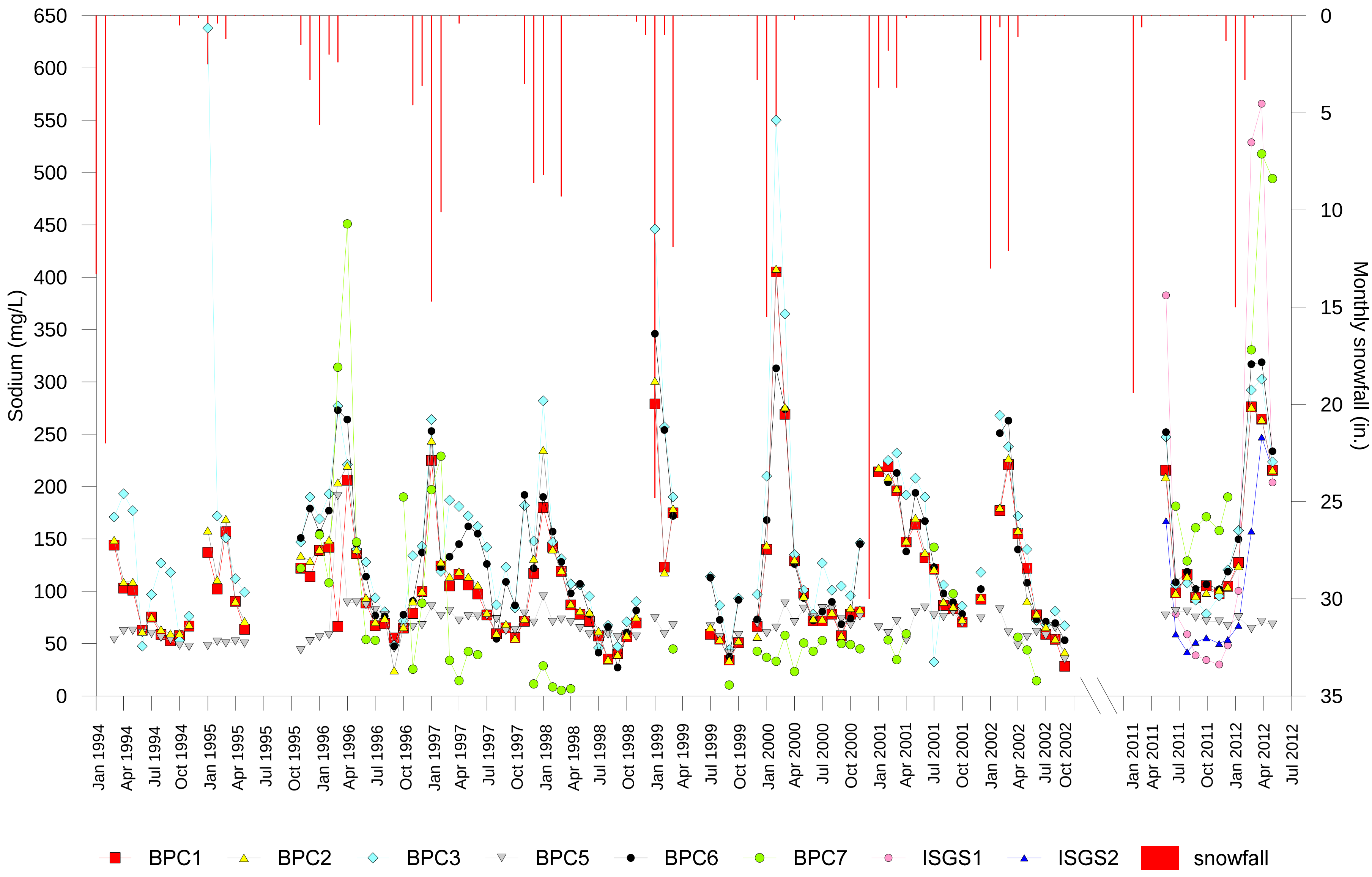


Figure 10. Comparison of sodium in grab samples collected before and after construction of I-355.

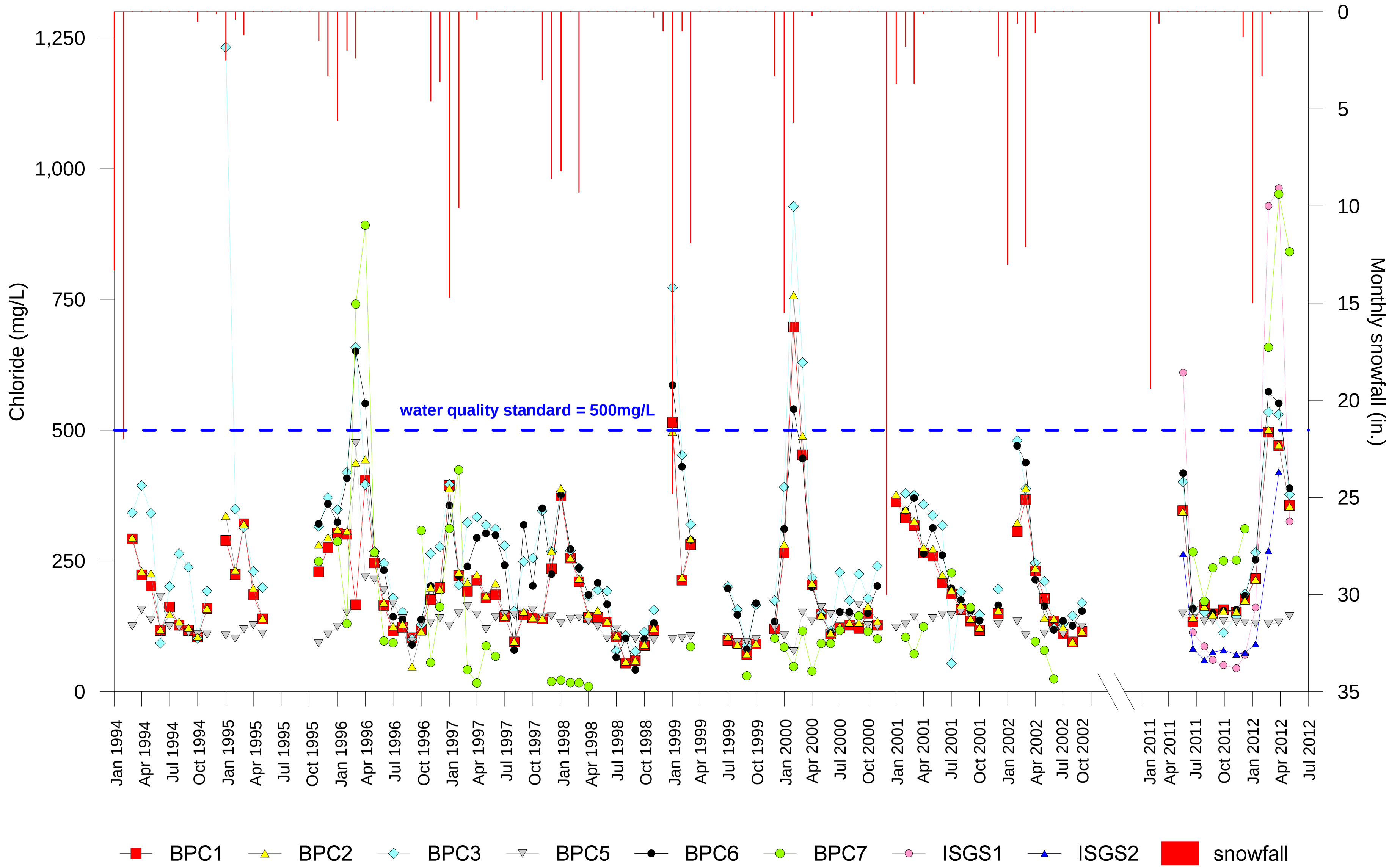


Figure 11. Comparison of chloride in grab samples collected before and after construction of I-355.

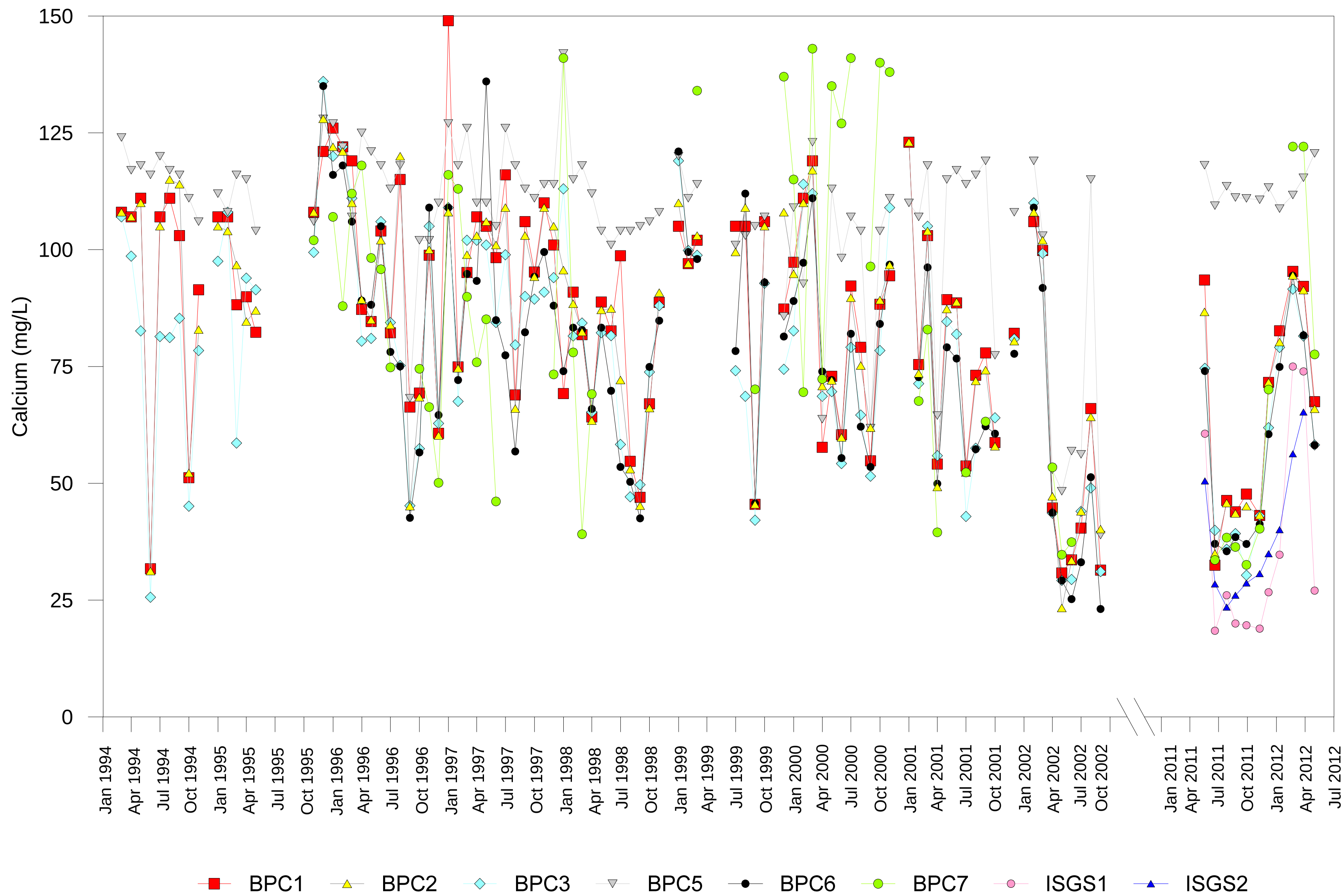


Figure 12. Comparison of calcium in grab samples collected before and after construction of I-355.

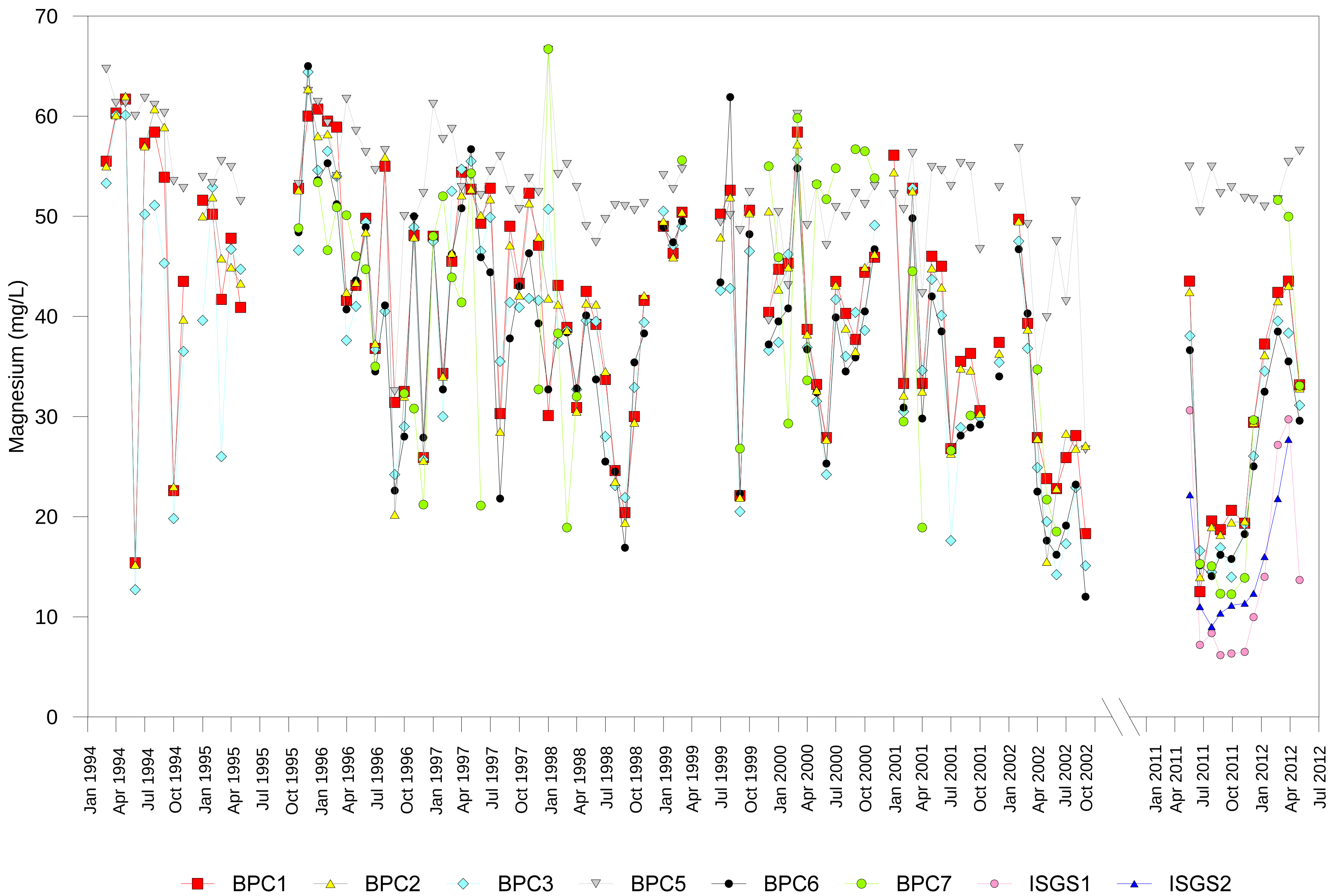


Figure 13. Comparison of magnesium in grab samples collected before and after construction of I-355.

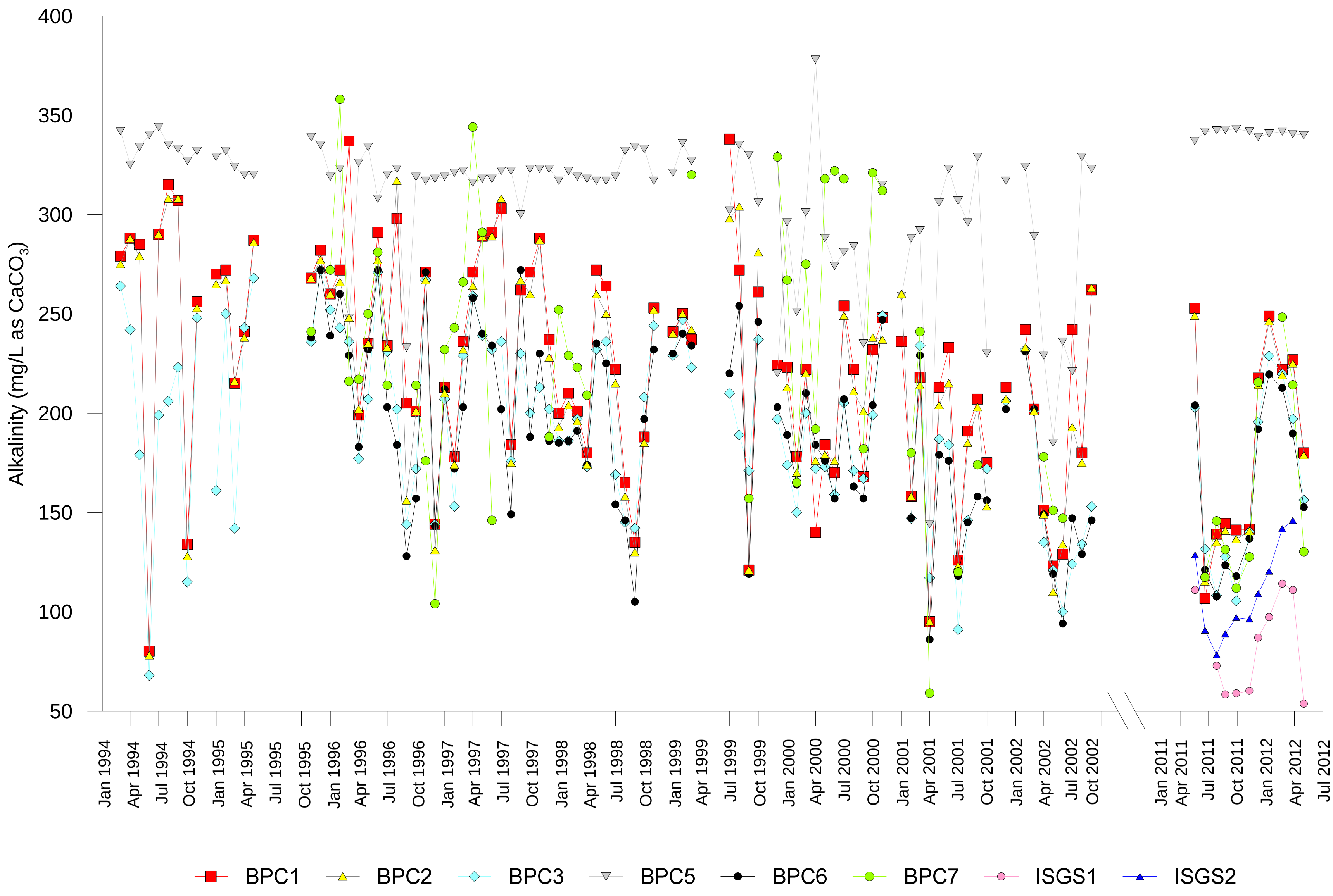


Figure 14. Comparison of alkalinity in grab samples collected before and after construction of I-355.

pre-construction data, likely as a result of the development of the Internationale Parkway industrial complex, and the associated increase in runoff, which would act to dilute these parameters. Post-construction concentrations of calcium, magnesium, and alkalinity in surface-water samples generally fall within the range of values measured toward the end of the pre-construction data, with no apparent spatial or temporal trends observed, thus indicating I-355 is having no discernable impact to water quality in Black Partridge Creek with respect to these constituents.

As compared to pre-construction results, mean concentrations of calcium, magnesium, and alkalinity in post-construction samples collected from the seep increased at the following percent increases: +6%, +1%, and +11%, respectively (Appendix F, Table 4), with only the increases in mean calcium and alkalinity considered to be statistically significant (Appendix G, Table 4). However, calcium, magnesium, and alkalinity levels in pre-construction samples from the seep were more variable than in post-construction samples, again suggesting that the locations sampled by the ISGS and INHS, and herein collectively referred to as BPC5, were not exactly the same, or the sampling point may have varied during pre-construction sampling (Figures 12, 13, and 14). Therefore, care is needed when considering these results. Lastly, from late 1999 through 2000, concentrations of calcium, magnesium, and alkalinity remained at relatively high levels in the I-355 tributary for an extended period of time. Taylor et al. (2001) observed during field visits in 1999 that excessive silt was being washed into the I-355 tributary from the recently constructed Champion Corporation building adjacent to the tributary (Figure 2). Additionally, Taylor et al. (2001) noted that discharge from a hydrant on the Champion Corporation property provided most and sometimes all of the flow in the tributary as observed on field visits in May, August, October, and December 1999. It is therefore possible that the elevated calcium, magnesium, and alkalinity concentrations measured during this period were somehow related to discharge from the hydrant, the excess silt from construction, or a combination of the two.

Sulfate

Sulfate was detected in 100% of pre- and post-construction samples (Appendix F). As compared to pre-construction values, minimum, maximum, and mean sulfate concentrations decreased at all sample locations in the creek (BPC1, BPC2, BPC3, BPC6) and the I-355 tributary (BPC7), with the largest percent decrease in means (-53%) measured in the I-355 tributary. All decreases in mean sulfate measured in the stream and the I-355 tributary were determined to be significant, while a slight percent increase (+2%) in mean sulfate in the seep (BPC5) was not considered significant (Appendix G, Table 4).

Pre- and post-construction concentrations of sulfate are plotted together in Figure 15. A general decrease in sulfate concentrations over time is observed in the pre-construction data. Soluk et al. (2003) noted in their report that maximum annual sulfate concentrations decreased over time, from 150 mg/L in 1994 to 100 mg/L in 2002. Not including the seep, maximum sulfate concentrations measured in post-construction samples ranged from 74.3 to 83.1 mg/L, thus continuing the downward trend observed for maximum values (Appendix F).

From late 1999 through 2000, levels of sulfate measured in the I-355 tributary were typically higher than at all other locations, likely related to discharge from the hydrant at the Champion Corporation building, construction of the building, or a combination of the two (as discussed for calcium, magnesium, and alkalinity above). Post-construction concentrations of sulfate in surface-water samples generally fell within the range of values measured toward the end of the pre-construction data. This suggests the observed changes occurred prior to the opening of I-355, and therefore I-355 may not be having any discernable impact on water quality in Black Partridge Creek with respect to sulfate.

In general, pre- and post-construction sulfate concentrations increased downstream. Beginning in April 2001, maximum sulfate concentrations in samples collected from the creek (BPC1, BPC2,

Figure 15. Comparison of sulfate in grab samples collected before and after construction of I-355.

BPC3, BPC6) and the I-355 tributary (BPC7) generally were lower than the concentration measured in the sample from the seep (BPC5) collected on that day (Figure 15). This suggests that from April 2001 onward, naturally-occurring sulfate levels in groundwater, as represented by the samples from the seep, were being diluted by a higher proportion of precipitation-derived runoff, having lower sulfate concentrations. The final stages of development in the Internationale Parkway industrial complex occurred sometime between 1998 and 2002, thus providing a potential mechanism driving this suspected increase in runoff and resultant dilution of sulfate concentrations.

Potassium

Detections for potassium increased from 70-87% of pre-construction samples to 100% of post-construction samples (Appendix F). At the same time, the method detection limit (MDL) for potassium decreased from 1 mg/L for pre-construction analysis (Appendix E) to 0.016 mg/L for post-construction analysis (Appendix B). However, all post-construction detections were greater than the pre-construction MDL, so the results are not affected by the change in MDL.

In comparison to pre-construction results, maximum and mean potassium concentrations in post-construction samples increased in the I-355 tributary, with percent increases of +60% and +119%, respectively (Appendix F). Minimum potassium increased at all sampling locations, with the largest percent increase (+157%) also measured in the I-355 tributary. Mean potassium also increased in the seep (+5%), but decreased at all other locations. Only the increase in mean potassium in the I-355 tributary and the decreases in mean potassium in the creek at BPC3 and BPC6 are considered statistically significant (Appendix G, Table 4). The apparent decreases at BPC3 and BPC6 may be at least partially due to differences in sampling methods described at the beginning of this section, that could have resulted in higher concentrations of these metals in the pre-construction samples.

Pre- and post-construction concentrations of potassium through time are presented in Figure 16. Concentrations of potassium in post-construction samples collected in the stream (BPC1, BPC2, BPC3, BPC6) fall within the range of values measured in pre-construction samples, though maximum values are lower in the post-construction data. In the I-355 tributary, pre-construction concentrations never exceeded 6 mg/L, but increased in post-construction samples to approximately 5-10 mg/L. The primary source suspected for the increase in potassium observed in the I-355 tributary is roadway deicing along I-355 and Internationale Parkway, which could introduce potassium to the watershed as a trace mineral associated with the application of road salt. Another possible source, though not observed, is the application of potassium-rich fertilizer to the surrounding landscape during non-winter months. Numerous gaps in the pre-construction samples collected from the I-355 tributary, particularly the ones occurring over the wintertime when potassium levels conceivably could have been higher, might also account for the increase observed in the I-355 tributary.

Nitrate

Nitrate was detected between 93% and 100% of the time in pre-construction samples and between 56% and 91% of the time in post-construction samples (Appendix F), perhaps reflecting the increase from the pre-construction MDL for nitrate of 0.01 mg/L (Appendix E) to the post-construction MDL of 0.07 mg/L (Appendix B). However, even with the increased MDL, decreases in maximum and mean nitrate were measured at all locations, with the largest decreases measured in the I-355 tributary (-99% and -95%, respectively) (Appendix F). Mean decreases in the stream ranged from -81% to -83%, and the mean decrease in the seep was -69%. Increases in minimum nitrate were measured in the stream samples, and ranged from +31% at BPC2 to +824% at BPC6, but are not considered valid due to the increase in the MDL that resulted in exclusion of any post-construction detections below 0.07 mg/L. Decreases observed in mean nitrate concentrations at all sampling locations were determined to be statistically significant (Appendix G, Table 4).

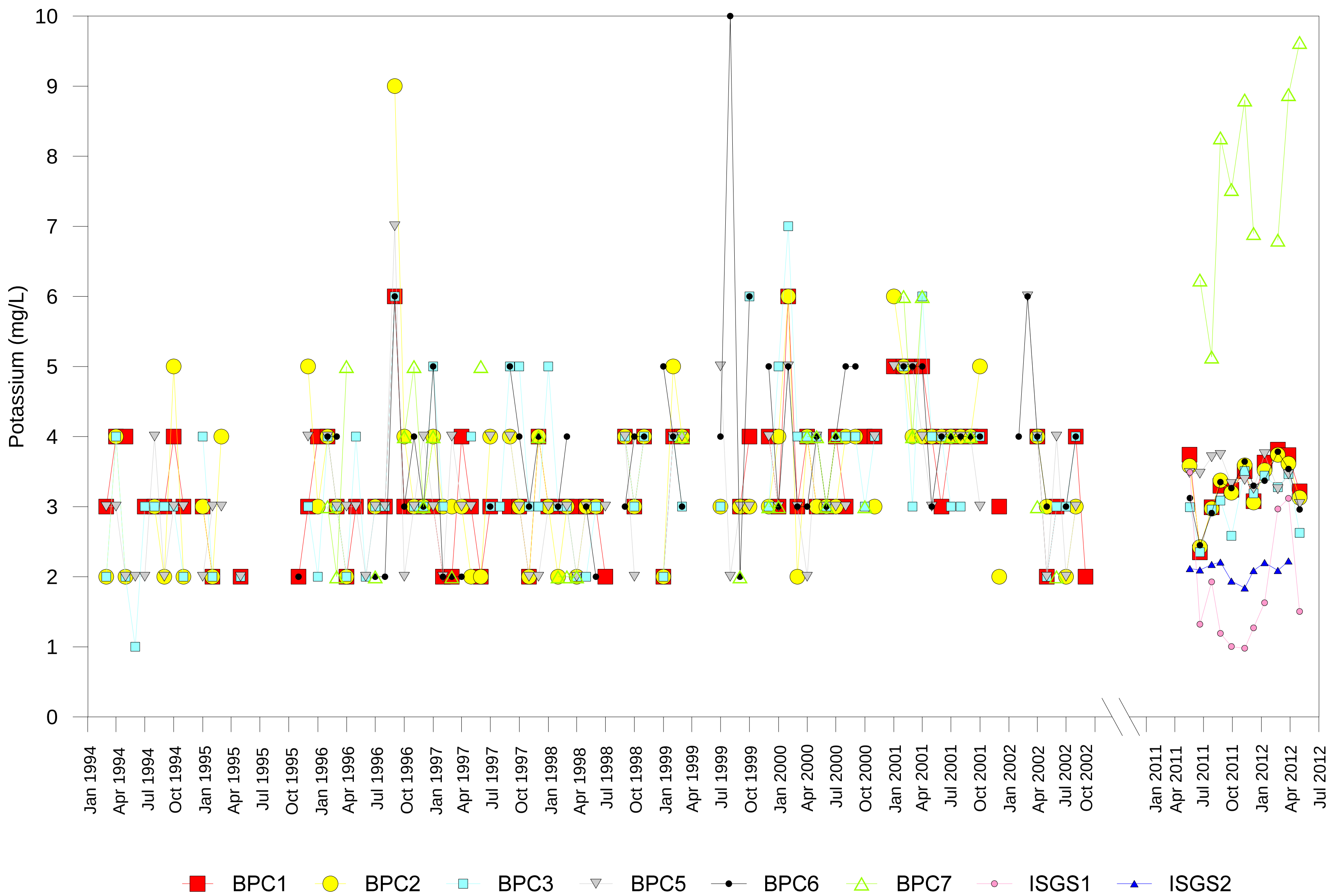


Figure 16. Comparison of potassium in grab samples collected before and after construction of I-355.

Pre- and post-construction nitrate levels through time are plotted in Figure 17. A notable decrease in overall nitrate levels occurred beginning in 1998, presumably as development of the Internationale Parkway industrial complex west of Morey Road and Woodward Avenue got underway and farmland in the watershed was increasingly taken out of production, thereby removing agricultural fertilizer as the most likely source of excess nitrogen in the watershed. Over the next several years, peak nitrate levels continued to decline as more farmland was converted. Post-construction levels were lower still, though subdued peaks were still present in spring and fall, possibly due to the application of fertilizer to the one remaining 11.3 ha (28 ac) agricultural field still in existence at the headwaters of the creek, immediately west of the I-55 interchange at Lemont Road.

Roadway Metals

Cadmium, Chromium, and Nickel

The following roadway metals of concern - cadmium, chromium, and nickel, were detected in pre-construction samples only (Appendix E). Cadmium had 4 detects, one each at BPC1, BPC2, BPC6, and the I-355 tributary (ranging from 0.01-0.02 mg/L, MDL=0.01); Chromium had 8 detects; one each at BPC1 and the I-355 tributary, and two each at BPC2, BPC3, and the seep (ranging from 0.01-0.02 mg/L, MDL=0.01); and Nickel had 11 detects, three at BPC2, two each at BPC1, the seep, and the I-355 tributary, and one each at BPC3 and BPC6. No plots were generated for these metals due to the low number of pre-construction detections and the lack of post-construction detections for each.

Miner et al. (2014) compared total metals versus dissolved metals as collected in grab samples of tollway runoff, and concluded that certain roadway metals of interest (chromium, copper, and zinc) predominantly occurred in non-dissolved form. Total metals analysis was not performed for this project, so both detections and concentrations of roadway metals of interest reported by the INHS and ISGS may be less than actually occur in the watershed.

Lead

Lead was detected a total of 4 times; 3 times before construction (twice at BPC2 and once in the I-355 tributary) (Appendix E) and 1 time following construction at BPC1 (Appendix B). Maximum lead concentrations decreased from 0.07 mg/L measured at BPC2 before construction to 0.042 mg/L measured at BPC1 after construction. No further analysis of lead was completed due to the small number of detections.

Copper

Copper was detected at all pre- and post-construction sample locations, with the greatest number of detections recorded at BPC6 both before and after construction (22% and 64% of samples, respectively) (Appendix F). By percentage, copper was detected more frequently at all post-construction sample locations, except the seep, which remained stable (9% after vs. 11% before). However, the increase in detections appears related to the MDL changing from 0.003 mg/L at the end of pre-construction monitoring (Appendix E) to 0.00079 mg/L at the beginning of post-construction monitoring (Appendix B), with more detections occurring at the more sensitive detection limits used for analyzing the post-construction samples. Only 2 of 30 (7%) post-construction detections of copper would have been detected using the original MDL, so statistical comparison of pre- and post-construction copper levels was not possible.

Pre- and post-construction concentrations of copper are presented in graphically in Figure 18. Large gaps exist in the pre-construction results, making analysis of spatial and temporal trends difficult. However, there does appear to be a decreasing trend in copper concentrations in the

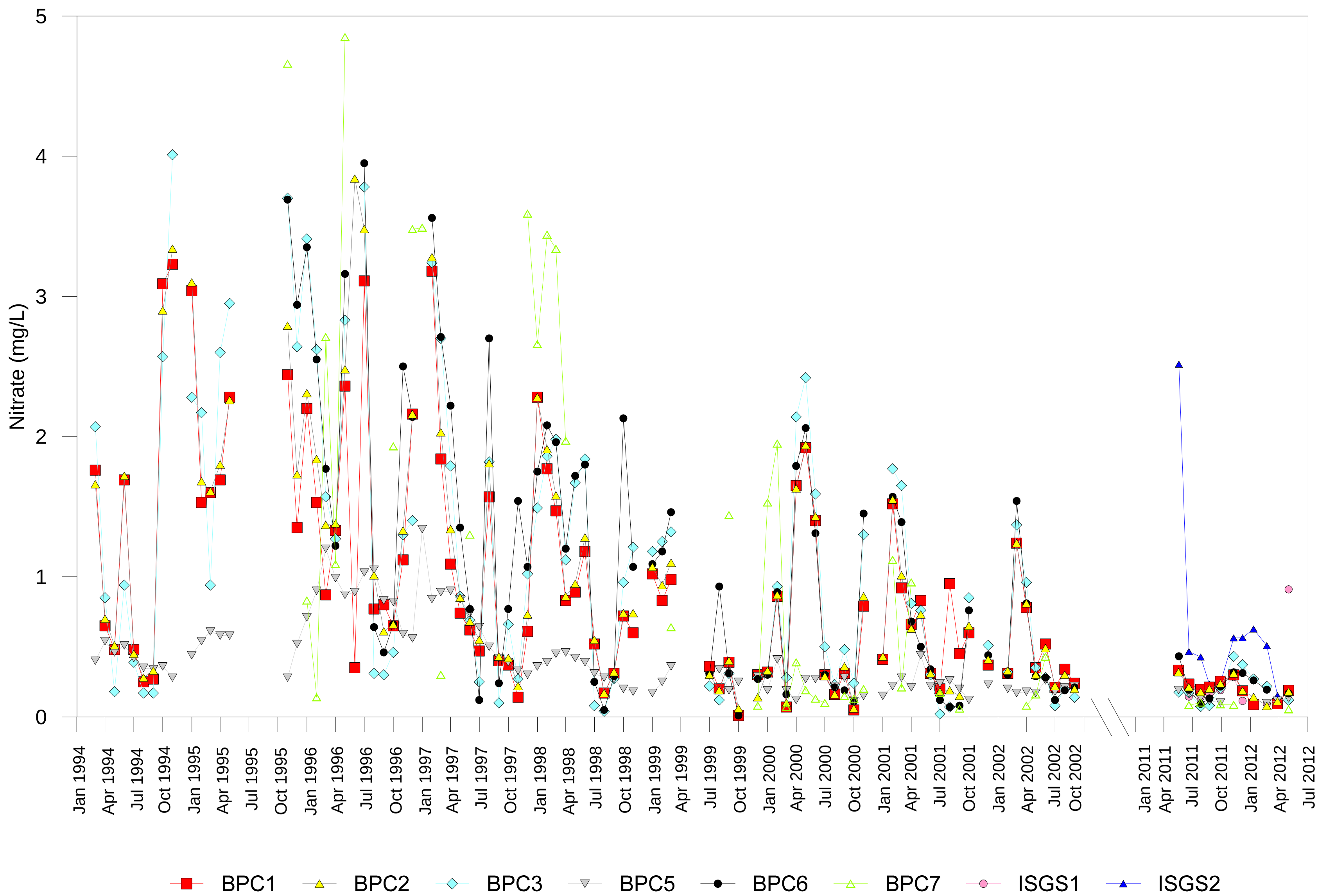


Figure 17. Comparison of nitrate in grab samples collected before and after construction of I-355.

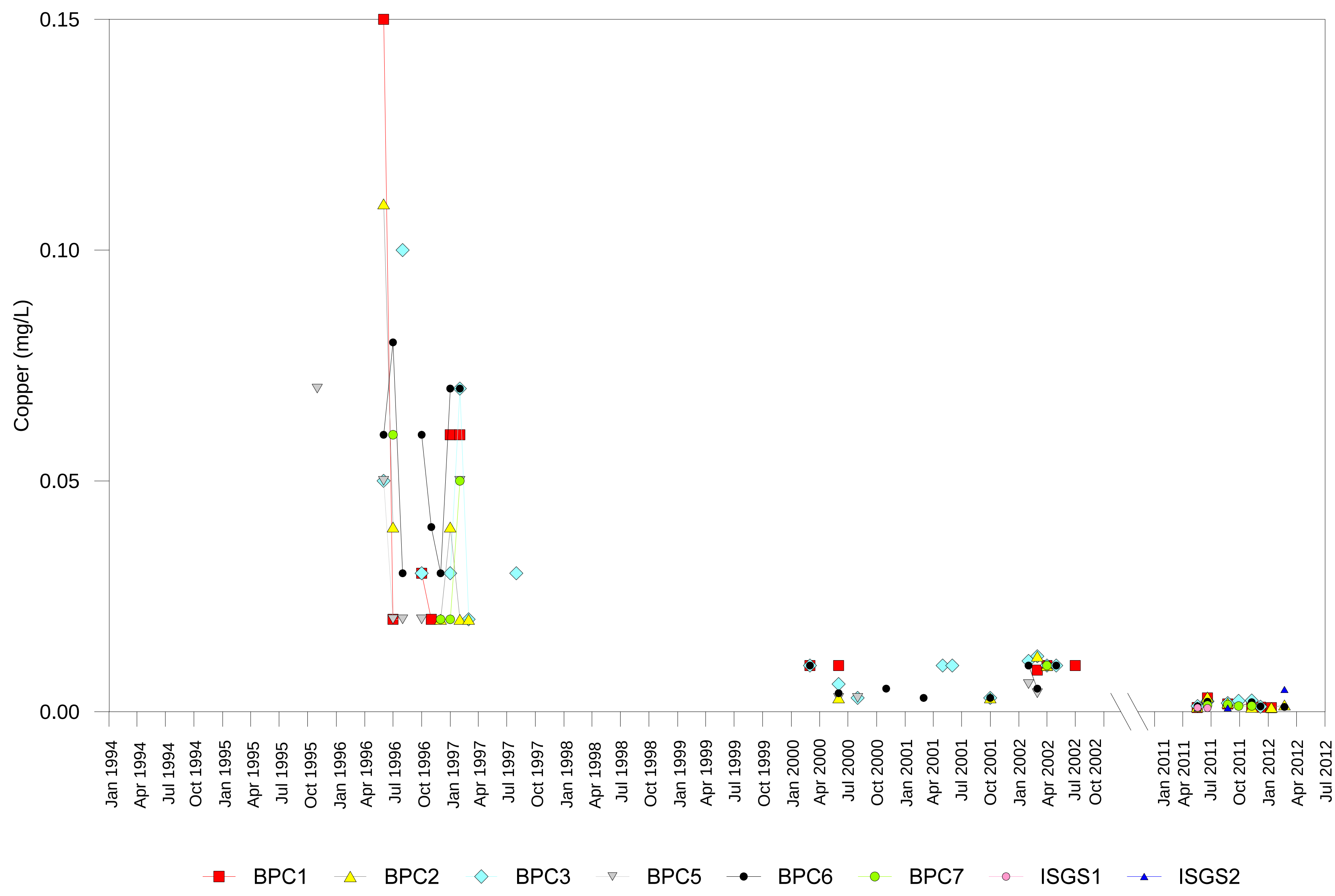


Figure 18. Comparison of copper in grab samples collected before and after construction of I-355.

watershed over time beginning prior to the opening of I-355, as evidenced by the decline in the maximum concentrations measured in samples toward the end of pre-construction monitoring, with a further decline observed in post-construction samples. It is likely that this trend toward decreasing copper concentrations is due in part to differences in sampling methods employed by the INHS and the ISGS.

Manganese

Maximum and mean manganese concentrations decreased at all sampling locations (Appendix F). However, these results are associated with a decrease in the MDL from 0.01 mg/L to 0.001 mg/L that occurred beginning in February 2000 (Appendix B and Appendix E), and resulted in additional lower-concentration detections in both pre- and post-construction samples that would not have been detected at the original MDL. For this reason, statistical analysis of manganese was not possible.

Pre- and post-construction concentrations of manganese are presented graphically in Figure 19. There is a general decrease in manganese concentrations over time, as evidenced by the overall decline in the maximum concentrations measured in pre-construction samples prior to the opening of I-355. It is likely that this trend is due in part to differences in sampling methods employed by the INHS and the ISGS. Manganese concentrations measured in post-construction samples generally fall within the range of values measured at the end of pre-construction monitoring, with no trends apparent.

Zinc

Zinc was detected 35-50% of the time at all locations in pre-construction samples, and only once in a post-construction sample from BPC3 (Appendix B and Appendix E), which was collected on 9/28/2011 following a heavy rain. A general decrease in zinc concentrations is observed over time (Figure 20), with maximum concentrations declining prior to the opening of I-355. The one post-construction measurement of zinc fell within the range of values measured at the end of pre-construction monitoring, but due to differences in sampling methods used by the INHS and the ISGS, no meaningful conclusions regarding zinc concentrations over time can be drawn from these results.

SUMMARY

Analysis and comparison of water-quality samples collected from the Black Partridge Creek watershed before and after construction of I-355 indicates that water quality in Black Partridge Creek has been and continues to be impacted by runoff from developed areas within in the watershed, including the recently constructed I-355 tollway, but also the light industrial complex surrounding and including Internationale Parkway and other nearby roadways, I-55, and a residential complex that were all developed before I-355. Impacts to the watershed are generated through two primary mechanisms; roadway operations (including wintertime roadway deicing activities) and increased surface-water runoff from the many impervious surfaces (roadways, buildings, and parking lots) that now dominate the upper reaches of the watershed.

TDS, sodium, and chloride concentrations in post-construction grab samples followed distinct seasonal patterns, with peaks occurring in the winter and spring, coincident with the deicing season. The highest maximum and mean TDS, sodium, and chloride concentrations were measured in the I-355 tributary and the east retention pond. In the I-355 tributary, the concentrations of these constituents remained greater than those measured in the creek throughout the post-construction monitoring period. In the creek, wintertime concentrations of TDS, sodium, and chloride at BPC3 were elevated with respect to samples collected downstream at BPC1 and BPC2, indicating inputs of these analytes were also occurring from the developed areas north of the

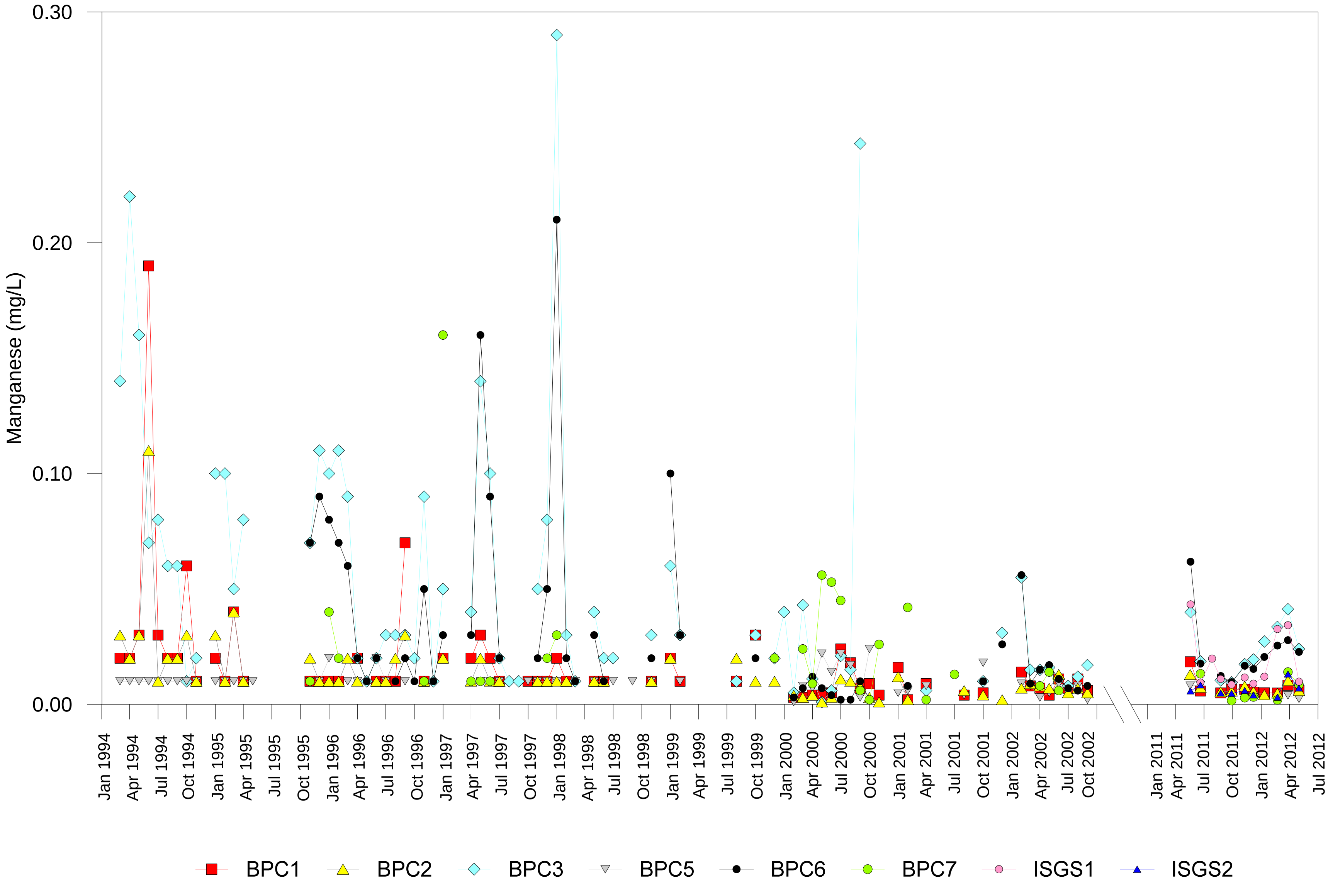


Figure 19. Comparison of manganese in grab samples collected before and after construction of I-355.

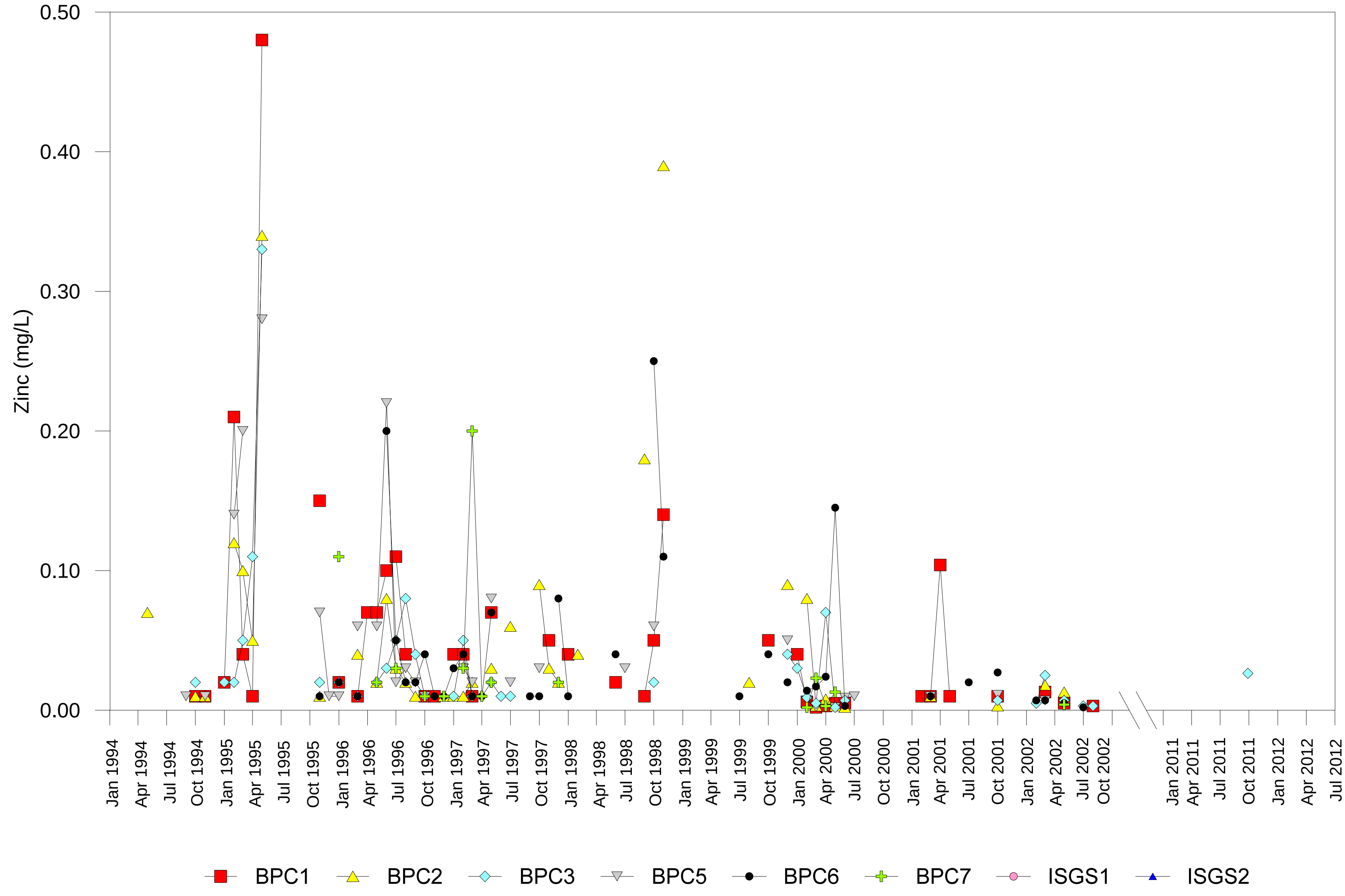


Figure 20. Comparison on zinc in grab samples collected before and after construction of I-355.

BPC3 sampling location. However, TDS, sodium, and chloride increased downstream from BPC3 to BPC6, indicating that inputs from the I-355 tributary and the east retention pond were having a greater impact on water quality in the creek with respect to these constituents. Furthermore, concentrations of sodium and chloride in the creek remained higher than levels measured in the seep throughout the year, indicating that impacts to water quality in the creek were long lasting, and did not cease once a particular deicing season ended. No measurable impacts to water quality in the creek were associated with runoff from Bluff Road, with respect to TDS, sodium, and chloride. Impacts observed in the I-355 tributary are likely generated by runoff from I-355 and Internationale Parkway, while impacts observed in the east retention pond appear to be associated with deicing of the parking lot immediately east of the pond.

Mean concentrations of TDS, sodium, and chloride measured in the I-355 tributary increased following construction of I-355, though only the increase in mean sodium and chloride were determined to be statistically significant. This indicates that runoff from I-355 is impacting water quality in Black Partridge Creek with respect to sodium and chloride. Elevated levels of TDS, sodium, and chloride were also measured in pre-construction samples from the creek dating back to 1994, indicating runoff from previously developed areas within the watershed was influencing water quality in the creek prior to construction of I-355.

Measurements of specific conductivity exhibited similar spatial and seasonal patterns as observed in grab samples for TDS, sodium, and chloride. Levels were generally highest in the I-355 tributary and the east retention pond, and increasing specific conductivity levels downstream from BPC3 to BPC6 suggests that surface-water inputs from both the I-355 tributary and the east retention pond were impacting water quality in Black Partridge Creek. During the summer and fall months, specific conductivity at BPC1 was similar to the seep and was generally greater than specific conductivity at BPC3, suggesting a higher percentage of groundwater contributing to flow in the lower reaches of the creek. In the winter and spring months, specific conductivity levels were greatest at BPC3 due both to it's proximity to the developed areas in the watershed and as a result of deicing activities in those areas. Large spikes in specific conductivity were recorded by all three data loggers during the winter months, reflecting the flushing of sodium and chloride ions dissolved from road salt through the watershed following deicing of roadways and parking lots. Bluff Road did not appear to influence specific conductivity measurements in Black Partridge Creek.

Chloride exceeded the General Use Standard in grab samples a total of 11 times at the following locations: BPC2, BPC3, BPC6, the I-355 tributary, and east retention pond. All chloride exceedances measured in grab samples were from samples collected during the months of February, March, and May, and are assumed to be related to wintertime deicing activities in the developed northern reaches of the watershed. Specific conductivity measurements recorded by ISGS data loggers predicted that the General Use Standard for chloride in surface water was met or exceeded at BPC1, BPC3, and the west retention pond several times between January and April 2012.

Decreases were measured in the mean concentrations of calcium, magnesium, alkalinity, and sulfate in the I-355 tributary (BPC7) and at the 4 sampling locations in the creek (BPC1, BPC2, BPC3, BPC6). All decreases were determined to be statistically significant, except for the decrease in calcium in the I-355 tributary and the decrease in alkalinity at BPC3, and are attributed to dilution from increased surface-water runoff resulting from development within the watershed. Post-construction concentrations of calcium, magnesium, and alkalinity were generally within the range of values observed toward the end of pre-construction monitoring, indicating the decreases pre-dated construction of I-355. Sulfur was not analyzed in pre-construction monitoring.

Calcium, magnesium, alkalinity, sulfur, and sulfate concentrations in the creek, the retention ponds, and the I-355 tributary were generally lower than in the seep throughout the post-construction monitoring period. The lowest levels of these analytes were measured during the summer and fall, when precipitation and the resulting runoff from developed areas were greatest. Concentrations generally increased downstream, indicating runoff was diluting these analytes relative to background concentrations as measured in the seep. Wintertime peaks in calcium and magnesium measured in the I-355 tributary may be indicative of trace elements associated with the salt used for deicing, but there was no apparent impact on the average concentrations of these elements (or on the average concentrations of alkalinity, sulfur, or sulfate) in the stream as a result of runoff from the I-355 tributary. Likewise, the small differences observed in average concentrations of these analytes measured at BPC1 and BPC2 suggest that runoff from Bluff Road was not having any apparent impact to water quality in Black Partridge Creek.

TSS levels were generally highest in the creek, followed by the I-355 tributary, the retention ponds, and the seep. Most TSS detections occurred in the summer and fall when rainfall and runoff amounts were higher and resulted in greater mobilization of sediment, and most detections were measured at BPC3 and BPC6, reflecting their proximity to the impervious surfaces of the developed areas in the watershed, which would contribute larger volumes of runoff and thus entrain more sediment and organic matter, primarily from the cattail marshes and retention ponds dotting the watershed. Total suspended solids were not analyzed in pre-construction monitoring.

Mean turbidity measurements recorded by ISGS data loggers were highest at BPC3, followed by the west retention pond (ISGS2), then BPC1. Spikes in turbidity were strongly correlated to precipitation events, and reflect entrainment of sediment and organic matter during those events. Higher turbidity at BPC3 and the west retention pond reflects the proximity of these sampling locations to runoff generated by development, while lower levels at BPC1 reflect the settling out of sediment as it is transported downstream. Turbidity levels measured in the creek were generally highest in winter and spring, most likely as a result of higher rates of erosion while plants are dormant or dead. Turbidity levels measured at ISGS2 were highest in Summer 2011 and again in Winter-Spring 2012, possibly indicating drier conditions in the pond which allowed for greater mobilization of sediment during storm events. Spikes in turbidity measured at ISGS2 could also indicate influence from turbid water being flushed from the I-355 tributary during high-flow events.

Minimum, maximum, and mean potassium concentrations were greatest in the I-355 tributary and remained elevated with respect to the seep throughout the year, while concentrations measured at all other locations remained near or below levels measured in the seep. Seasonal trends in potassium were subtle and difficult to determine, but the east retention pond exhibited higher concentrations in the winter and spring months, and the two highest levels measured in the I-355 tributary occurred in March and May 2012, possibly as a result of trace minerals associated with the application of road salt during wintertime deicing activities. While potassium concentrations in the east retention pond were diluted in the summer and fall, levels in the I-355 tributary were more variable, with relatively high concentrations measured in the summer and fall, reflecting either inefficient flushing from the I-355 tributary of potassium stored from previous deicing activities along I-355 and Internationale Parkway, or possibly the application of potassium-rich fertilizer to the surrounding landscape. When compared to pre-construction results, a statistically significant increase in mean potassium was measured in the I-355 tributary, and a statistically significant decrease in mean potassium was measured in the creek at both BPC3 and BPC6, perhaps due to additional dilution from increased runoff as a result of development in the watershed.

Post-construction concentrations of minimum, maximum, and mean nitrate were greatest in the west retention pond. Distinct seasonal and spatial patterns in nitrate were difficult to discern, but levels generally increased downstream from May-October 2011, and decreased downstream from November 2011-February 2012. Nitrate concentrations in the west retention pond were highest from Spring 2011 and again in Fall and Winter 2011/2012, possibly as a result of seasonal applications of fertilizer to the surrounding landscape. In May 2011, nitrate was detected at the highest concentration of all post-construction samples, while at the same time nitrate concentrations in Black Partridge Creek increased downstream from BPC3 to BPC6, reflecting an obvious impact to water quality in the creek due to water flowing from the west retention pond. Nitrate levels in the watershed have steadily decreased over time, apparently due to development within the watershed and the subsequent decrease in farmland and the agricultural fertilizers which were likely applied to that land. Statistically significant decreases in mean nitrate levels were observed at all sampling locations.

Total and dissolved non-volatile organic carbon concentrations in post-construction samples were greatest in the I-355 tributary and BPC3, and generally decreased downstream. The higher concentrations in the upper reaches of the watershed are most likely due to proximity of the sampling locations to sources of organic matter, including the cattail marshes and the retention ponds, as well as proximity to developed areas that generate higher amounts of runoff that are effective at flushing this organic matter into the creek. Additional NVOCs washed from I-355, Internationale Parkway, and I-55 may also have contributed to the higher concentrations measured in the I-355 tributary and at BPC3. Concentrations of tNVOC and dNVOC were higher from late spring through fall, when organic material is more readily available and mobilization of this matter is more frequent due to increased precipitation. Decreases in total and dissolved NVOC concentrations observed at the bottom of the watershed are due to increasing groundwater inputs, which are naturally lower in organic matter, and the settling out and uptake by biota of organic matter from the creek as it flows through the watershed. Only slight differences were measured in dNVOC and tNVOC at BPC1 and BPC2, suggesting Bluff Road had no appreciable impact on the creek with respect to these analytes. Because of differences in analytical methods employed during the INHS and the ISGS portions of this study, a direct comparison of total and dissolved NVOCs in the watershed before and after construction of I-355 was not feasible.

Cadmium, chromium, and nickel were detected in pre-construction samples only, and lead was detected a total of 4 times in pre- and post-construction samples. No further analysis of these metals was completed for this study, but it appears that the construction of I-355 has not increased their occurrence within the watershed.

Copper was detected a total of 35 times out of 86 post-construction samples, most frequently in the I-355 tributary, but the highest mean concentrations were detected in samples from BPC3 and the west retention pond. Occurrence and concentrations of copper tended to be higher in samples collected following rainfall events, presumably due to transport while bound to sediment. Concentrations of copper generally decreased downstream from BPC3 to BPC6 and from BPC2 to BPC1, suggesting the I-355 tributary and Bluff Road were not impacting water quality in the creek with respect to copper. Because of a change in the MDL for copper, statistical comparison of pre- and post-construction copper concentrations in Black Partridge Creek was not possible. While there does appear to be a decrease in copper concentrations over time, this decrease started prior to the opening of I-355, and is likely due in part to differences in sampling methods employed by the INHS and the ISGS.

Manganese concentrations in post-construction samples were greatest at BPC3 and BPC6, and decreased downstream likely due to dilution by groundwater. Wet conditions during the winter and spring likely lead to reducing conditions in the cattail marshes and retention ponds in the upper part of the watershed, resulting in higher dissolved manganese concentrations. Manganese concentrations in post-construction samples did not appear to be influenced by either the I-355 tributary or Bluff Road. Comparison of pre- and post-construction manganese showed concentrations generally decreased over time, beginning prior to the opening of I-355. This decrease is likely due in part to differences in sampling methods employed by the INHS and the ISGS. Manganese concentrations measured in post-construction samples generally fell within the range of values measured at the end of pre-construction monitoring, with no trends apparent. Statistical analysis of manganese concentrations over time was not possible due to differences in sampling methods and a change in the MDL.

A general decrease in zinc concentrations was observed over time, with maximum concentrations declining prior to the opening of I-355. The one post-construction measurement of zinc fell within the range of values measured at the end of pre-construction monitoring, but due to differences in sampling methods used by the INHS and the ISGS, no meaningful conclusions regarding zinc concentrations over time could be drawn from these results.

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REFERENCES

Berg, R.C. and J.P. Kempton, 1988, Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters: Illinois State Geological Survey Circular 542, Champaign, Illinois, 23 p.

Campbell, M.C., J.J. Miner, and K.W. Carr, 2011, Data and Results of Monitoring At the Unnamed Tributary to the South Branch of Indian Creek (Willowbrook Drain), IL 22, near Long Grove, IL: Illinois State Geological Survey Open-File Report 2011-5, Prairie Research Institute, University of Illinois, Champaign, 34 p.

Google, Inc., 2010, Google Earth (Version 6.0.1.2032 (beta)) [Software]. Available from http://www.google.com/earth/.

Hach Company, 2006, Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes, User Manual, February 2006, Edition 3: Catalog number 003078HY, Loveland, CO, 73 p.

Hansel, A.K. and W.H. Johnson, 1996, Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area: Illinois State Geological Survey Bulletin 104, Champaign, Illinois, 116 p.

Herzog, B., B. Stiff, C. Chenoweth, K. Warner, J. Sieverling, and C. Avery, 1994, Buried Bedrock Surface of Illinois: Illinois State Geological Survey, Illinois Map 5, Champaign, Illinois, map scale 1:500,000, 1 sheet.

Illinois Environmental Protection Agency, Division of Water Pollution Control, 2006, Public Notice/Fact Sheet of Draft Reissued NPDES Permit to Discharge into Waters of the State, Springfield, Illinois, 10 p, available online at http://www.epa.state.il.us/public-notices/2006/illinois-american-water-lemont/index.pdf.

Illinois Pollution Control Board, undated, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 302 Water Quality Standards, available online at http://www.ilga.gov/commission/jcar/admincode/titles.html.

Illinois State Geological Survey, 2014, USGS Digital Raster Graphic (DRG) Files, Illinois Geospatial Data Clearinghouse, Champaign, Illinois, available online at http://crystal.isgs.uiuc.edu/nsdihome/webdocs/drgs/.

Kolata, D. (compiler), 2005, Bedrock Geology of Illinois: Illinois State Geological Survey, Illinois Map 14, Champaign, Illinois, map scale 1:500,000, 2 sheets.

Midwestern Regional Climate Center, 2014, cli-MATE: the MRCC's Application Tools Environment, Illinois State Water Survey, Champaign, Illinois, available online at http://mrcc.isws.illinois.edu/CLIMATE/.

Miner, J.J., K.W. Carr, and K.E. Bryant, 2012a, Pre-Construction Monitoring at Bioswale Installation Sites Along I-294 in Northern Cook County, Illinois: ISGS Open-File Series 2012-3, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL, 81 p.

Miner, J.J., K.W. Carr, K.E. Bryant, M.E. Campbell, and J.R. Ackerman, 2012b, Year 1 Post-Construction Monitoring at Bioswale Installation Sites Along I-294 in Northern Cook County, Illinois: unpublished contract report to the Illinois State Toll Highway Authority, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL, 81 p.

Miner, J.J., K.W. Carr, K.E. Bryant, M.C. Higley, J.R. Ackerman, E.T. Plankell, and C.M. Long, 2013, Year 2 Post-Construction Monitoring at Bioswales Along I-294 in Northern Cook County, Illinois: unpublished contract report to the Illinois State Toll Highway Authority, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL, 131 p.

Miner, J.J., K.W. Carr, K.E. Bryant, M.C. Higley, J.R. Ackerman, E.T. Plankell, and C.M. Long, 2014, Year 3 Post-Construction Monitoring at Bioswales Along I-294 in Northern Cook County, Illinois: unpublished contract report to the Illinois State Toll Highway Authority, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL, 178 p.

National Atmospheric Deposition Program (NRSP-3), 2014, NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820, online at http://nadp.sws.uiuc.edu/.

Paul, Michael J., and Judy L. Mayer, 2008, Streams in the Urban Landscape, in Urban Ecology: Marzluff, J., Shulenberger, E., Endlicher, W., Alberti, M., Bradley, G., Ryan, C., Simon, U., ZumBrunnen, C.: Springer US, p. 207-231.

Piskin, K., and R. Bergstrom, 1975, Thickness of Glacial Drift in Illinois: Illinois State Geological Survey, Circular 490, Champaign, Illinois, 34 p.

Plankell, E.T. and J.J. Miner, 2014, Water-Quality Impacts to a Forested Fen as a Result of Roadway Deicing Activities: Joint Aquatic Sciences Meeting, Portland, Oregon, May 18-23, 2014. (Abstract ID: 14547).

Soluk, D.A., J.A. Steinmetz, J. Sandberger, L.L. Zuehls, H.D. Vance-Chalcraft, K.L. Moss, 2003, Black Partridge Creek Water Quality Assessment (1994-2002): Final Report (Spring 2003), Center for Aquatic Ecology, Illinois Natural History Survey, Champaign, Illinois, 91 p.

Soluk, D.A., H. Britten, C.D. Satyshur, R. DeMots, J. Holmes, A.T. Hinkle, 2009, Evaluation of the potential impacts of the I355 extension on the ecology, behavior, population genetics and distribution of the endangered Hine's emerald dragonfly (Somatochlora hineana) in the Des Plaines River Valley - Report of Activities in 2008: Department of Biology, University of South Dakota, contract report submitted to Illinois State Toll Highway Authority, 41p.

Taylor, S.J., M.J. Wetzel, R.E. DeWalt, and C.A. Taylor, 2001, An Assessment of the Aquatic Resources of Black Partridge Creek Basin, Cook and DuPage Counties, Illinois: Surveys for Fishes and Aquatic Macroinvertebrates (IDOT FAP 340, Project No. P-91-315-86). Illinois Natural History Survey Center for Biodiversity, Technical Report 2001 (2), 43p.

U.S. Department of Agriculture-Farm Service Agency, 2012, National Agricultural Imagery Program, Aerial Photography Field Office, Salt Lake City, Utah, available online at http://datagateway.nrcs.usda.gov/GDGOrder.aspx.

U.S. Environmental Protection Agency, 1997, Volunteer Stream Monitoring: A Methods Manual. Office of Water, United States Environmental Protection Agency, EPA 841-B-97-003.

U.S. Fish and Wildlife Service, 2013, Hine's Emerald Dragonfly, *Somatochlora hineana* (Odonata: Corduliidae), 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Midwest Region, Chicago Ecological Services Field Office, Barrington, Illinois, 50p.

Watershed Boundary Dataset for {county, state, or HUC#}, State [Online WWW]. Available URL: "http://datagateway.nrcs.usda.gov" [Accessed DD/MM/YYYY].

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey Bulletin 95, Urbana, Illinois, 261 p.

APPENDIX A: Analytes Measured and Laboratory Methodologies Used For Post-Construction Sample Analysis

Analytes and Laboratory Methodologies

SM = "Standard Methods for the Examination of Water and Wastewater": APHA, AWWA, & WEF

USEPA = methods by the US Environmental Protection Agency

Parameter	Analytes	Analytical Methodology	Field Preservation
Alkalinity	Alkalinity	SM Method 2320B - Titrimetric	Cool to 4°C
Anions	F, Cl, NO_3, SO_4	USEPA Method 300.0 - Ion Chromatography	Cool to 4°C, Filter
Metals, dissolved	Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn	USEPA Method 200.7 - Inductively Coupled Plasma (ICP)	Cool to 4°C, Filter, HNO_3
Ammonia/ammonium	NH_3 -N	USEPA Method 350.1 - Colorimetry	Cool to 4°C, H_2SO_4
Orthophosphate	oPO_4-P	USEPA Method 365.1 - Colorimetry	Cool to 4°C, Filter
Non-volatile organic carbon (NVOC)	total NVOC, dissolved NVOC	SM Method 5310B - High temperature combustion	Cool to 4°C, Filter (dissolved), H_3PO_4
Total dissolved solids (TDS)	TDS, 180 C	SM Method 2540C - Dried at 180° C	Cool to 4°C, Filter
Total suspended solids (TSS)	TSS	SM Method 2540D - Dried at 103-105° C	Cool to 4°C
pH	pH	USEPA Method 150.1 - Electrometric	Cool to 4°C

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L
						MDL:	0.037	0.11	0.023	0.00085	0.00055	0.029	0.012	0.013	0.0058	0.00079	0.024	0.016	0.11	0.027	0.0015
5/18/2011	**BPC1**	13:40	8.08	nr	11.78	TOLLWAY 882	<0.037	<0.11	0.076	0.0648	<0.00055	93.5	<0.012	<0.013	<0.0058	0.00091	0.027	3.74	<0.11	43.5	0.0184
6/20/2011	**BPC1**	13:21	7.90	693	21.72	TOLLWAY 938	<0.037	<0.11	0.039	0.0284	<0.00055	32.5	<0.012	<0.013	<0.0058	0.00300	0.062	2.35	<0.11	12.5	0.0058
7/27/2011	**BPC1**	10:50	7.84	902	22.03	TOLLWAY 1007	<0.037	<0.11	0.026	0.0283	<0.00055	46.3	<0.012	<0.013	<0.0058	<0.00079	0.024	2.99	<0.11	19.6	<0.0015
8/24/2011	**BPC1**	13:43	7.85	829	23.19	TOLLWAY 1069	<0.037	<0.11	0.050	0.0378	<0.00055	43.9	<0.012	<0.013	<0.0058	0.00169	0.037	3.30	<0.11	18.7	0.0050
9/28/2011	**BPC1**	12:01	7.96	856	15.37	TOLLWAY 1162	<0.037	<0.11	0.052	0.0367	<0.00055	47.7	<0.012	<0.013	<0.0058	<0.00079	0.058	3.24	<0.11	20.6	0.0065
11/9/2011	**BPC1**	13:11	7.58	838	10.20	TOLLWAY 1213	<0.037	<0.11	0.053	0.0353	<0.00055	43.1	<0.012	<0.013	<0.0058	0.00109	0.032	3.51	<0.11	19.3	0.0065
12/7/2011	**BPC1**	16:23	8.01	1091	3.87	TOLLWAY 1286	<0.037	<0.11	0.066	0.0448	<0.00055	71.6	<0.012	<0.013	<0.0058	0.00099	<0.024	3.08	<0.11	29.4	0.0053
1/11/2012	**BPC1**	14:16	8.10	1284	5.79	TOLLWAY 1342	<0.037	<0.11	0.067	0.0575	<0.00055	82.6	<0.012	<0.013	<0.0058	0.00088	<0.024	3.63	<0.11	37.2	0.0050
2/22/2012	**BPC1**	16:36	8.34	2178	5.54	TOLLWAY 1432	<0.037	<0.11	0.056	0.0684	<0.00055	95.4	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.81	<0.11	42.4	0.0049
3/27/2012	**BPC1**	11:21	8.24	1998	10.75	TOLLWAY 1522	<0.037	<0.11	0.072	0.0669	<0.00055	92.1	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.73	<0.11	43.5	0.0083
5/1/2012	**BPC1**	10:45	8.02	1571	12.66	TOLLWAY 1581	<0.037	<0.11	0.058	0.0567	<0.00055	67.5	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.22	<0.11	33.2	0.0061
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	0	11	11	0	11	0	0	0	6	6	11	0	11	10
						% Detects	0	0	100	100	0	100	0	0	0	55	55	100	0	100	91
		min	7.58	693	3.87	min	-	-	0.026	0.0283	-	32.5	-	-	-	0.00088	0.024	2.35	-	12.5	0.0049
		max	8.34	2178	23.19	max	-	-	0.076	0.0684	-	95.4	-	-	-	0.00300	0.062	3.81	-	43.5	0.0184
		mean	7.99	1224	13.0	mean	-	-	0.056	0.0478	-	65.1	-	-	-	0.0014	0.040	3.33	-	29.1	0.0072
		range	0.76	1485	19.32	range	-	-	0.050	0.0402	-	62.9	-	-	-	0.00211	0.038	1.47	-	31.0	0.0135
5/18/2011	**BPC2**	16:08	7.59	1710	12.19	TOLLWAY 885	<0.037	<0.11	0.074	0.0626	<0.00055	86.7	<0.012	<0.013	<0.0058	0.00105	<0.024	3.58	<0.11	42.4	0.0130
6/20/2011	**BPC2**	14:19	8.01	747	22.07	TOLLWAY 941	0.042	<0.11	0.041	0.0308	<0.00055	34.9	<0.012	<0.013	<0.0058	0.00318	0.097	2.42	<0.11	14.0	0.0073
7/27/2011	**BPC2**	12:03	7.87	883	22.79	TOLLWAY 1010	<0.037	<0.11	0.038	0.0277	<0.00055	45.7	<0.012	<0.013	<0.0058	<0.00079	0.024	2.97	<0.11	19.0	<0.0015
8/24/2011	**BPC2**	14:54	7.97	819	23.91	TOLLWAY 1072	<0.037	<0.11	0.047	0.0381	<0.00055	43.5	<0.012	<0.013	<0.0058	0.00189	0.050	3.37	<0.11	18.2	0.0054
9/28/2011	**BPC2**	12:58	8.00	840	15.48	TOLLWAY 1165	<0.037	<0.11	0.052	0.0354	<0.00055	45.1	<0.012	<0.013	<0.0058	<0.00079	0.074	3.20	<0.11	19.4	0.0057
11/9/2011	**BPC2**	14:17	7.85	845	9.87	TOLLWAY 1216	<0.037	<0.11	0.057	0.0357	<0.00055	43.1	<0.012	<0.013	<0.0058	0.00095	0.063	3.59	<0.11	19.5	0.0079
12/7/2011	**BPC2**	15:14	7.85	1075	4.15	TOLLWAY 1283	<0.037	<0.11	0.070	0.0451	<0.00055	71.6	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.06	<0.11	29.4	0.0056
1/11/2012	**BPC2**	14:46	7.90	1258	6.45	TOLLWAY 1343	<0.037	<0.11	0.065	0.0563	<0.00055	80.2	<0.012	<0.013	<0.0058	0.00092	<0.024	3.52	<0.11	36.1	0.0042
2/22/2012	**BPC2**	16:15	8.18	2188	5.44	TOLLWAY 1431	<0.037	<0.11	0.057	0.0674	<0.00055	94.5	<0.012	<0.013	<0.0058	0.00147	<0.024	3.74	<0.11	41.5	0.0049
3/27/2012	**BPC2**	12:01	8.00	1991	11.20	TOLLWAY 1524	<0.037	<0.11	0.073	0.0672	<0.00055	91.3	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.61	<0.11	43.1	0.0103
5/1/2012	**BPC2**	11:07	7.92	1568	12.70	TOLLWAY 1582	<0.037	<0.11	0.057	0.0561	<0.00055	65.9	<0.012	<0.013	<0.0058	<0.00079	0.036	3.13	<0.11	32.8	0.0060
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	1	0	11	11	0	11	0	0	0	6	6	11	0	11	10
						% Detects	9	0	100	100	0	100	0	0	0	55	55	100	0	100	91
		min	7.59	747	4.15	min	0.042	-	0.038	0.0277	-	34.9	-	-	-	0.00092	0.024	2.42	-	14.0	0.0042
		max	8.18	2188	23.91	max	0.042	-	0.074	0.0674	-	94.5	-	-	-	0.00318	0.097	3.74	-	43.1	0.0130
		mean	7.92	1266	13.3	mean	0.042	-	0.057	0.0475	-	63.9	-	-	-	0.0016	0.057	3.29	-	28.7	0.0070
		range	0.59	1441	19.76	range	-	-	0.036	0.0397	-	59.5	-	-	-	0.00226	0.072	1.32	-	29.1	0.0088
5/19/2011	**BPC3**	10:24	8.24	1810	15.59	TOLLWAY 888	<0.037	<0.11	0.074	0.0607	<0.00055	74.6	<0.012	<0.013	<0.0058	0.00122	0.064	2.99	<0.11	38.0	0.0400
6/20/2011	**BPC3**	16:00	8.04	828	23.75	TOLLWAY 943	<0.037	<0.11	0.052	0.0338	<0.00055	39.9	<0.012	<0.013	<0.0058	0.00227	0.071	2.35	<0.11	16.6	0.0186
7/27/2011	**BPC3**	14:07	8.10	783	26.59	TOLLWAY 1012	<0.037	<0.11	0.023	0.0241	<0.00055	35.9	<0.012	<0.013	<0.0058	<0.00079	0.058	2.96	<0.11	14.4	<0.0015
8/24/2011	**BPC3**	16:44	7.97	776	26.53	TOLLWAY 1075	<0.037	<0.11	0.050	0.0368	<0.00055	39.2	<0.012	<0.013	<0.0058	0.00186	0.041	3.09	<0.11	16.9	0.0104
9/28/2011	**BPC3**	15:24	8.26	641	16.33	TOLLWAY 1170	0.138	<0.11	0.039	0.0260	<0.00055	30.3	<0.012	<0.013	<0.0058	0.00234	0.134	2.58	<0.11	14.0	0.0095
11/9/2011	**BPC3**	16:50	7.83	352	9.50	TOLLWAY 1221	0.101	<0.11	0.055	0.0353	<0.00055	43.0	<0.012	<0.013	<0.0058	0.00243	0.142	3.51	<0.11	19.2	0.0174
12/7/2011	**BPC3**	14:21	7.65	1067	3.64	TOLLWAY 1282	<0.037	<0.11	0.056	0.0471	<0.00055	61.9	<0.012	<0.013	<0.0058	0.00110	0.042	3.19	<0.11	26.0	0.0194
1/11/2012	**BPC3**	12:49	8.19	1397	4.33	TOLLWAY 1339	<0.037	<0.11	0.070	0.0635	<0.00055	79.1	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.44	<0.11	34.5	0.0272
2/22/2012	**BPC3**	14:02	8.39	2264	5.06	TOLLWAY 1425	<0.037	<0.11	0.061	0.0701	<0.00055	91.5	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.28	<0.11	39.5	0.0336
3/27/2012	**BPC3**	13:49	8.41	2094	14.26	TOLLWAY 1527	<0.037	<0.11	0.073	0.0652	<0.00055	81.5	<0.012	<0.013	<0.0058	<0.00079	0.066	3.46	<0.11	38.3	0.0412
5/1/2012	**BPC3**	9:12	8.19	1581	13.09	TOLLWAY 1577	<0.037	<0.11	0.056	0.0517	<0.00055	58.2	<0.012	<0.013	<0.0058	<0.00079	0.031	2.63	<0.11	31.1	0.0240
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	2	0	11	11	0	11	0	0	0	6	9	11	0	11	10
						% Detects	18	0	100	100	0	100	0	0	0	55	82	100	0	100	91
		min	7.65	352	3.64	min	0.101	-	0.023	0.0241	-	30.3	-	-	-	0.00110	0.031	2.35	-	14.0	0.0095
		max	8.41	2264	26.59	max	0.138	-	0.074	0.0701	-	91.5	-	-	-	0.00243	0.142	3.51	-	39.5	0.0412
		mean	8.12	1236	14.4	mean	0.119	-	0.055	0.0468	-	57.7	-	-	-	0.00187	0.072	3.04	-	26.2	0.024
		range	0.76	1912	22.95	range	0.037	-	0.051	0.0460	-	61.2	-	-	-	0.00133	0.111	1.16	-	25.6	0.0317

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L
						MDL:	0.037	0.11	0.023	0.00085	0.00055	0.029	0.012	0.013	0.0058	0.00079	0.024	0.016	0.11	0.027	0.0015
5/18/2011	**BPC5**	15:06	7.02	1228	10.94	TOLLWAY 884	<0.037	<0.11	0.096	0.0586	<0.00055	118	<0.012	<0.013	<0.0058	<0.00079	0.037	3.48	<0.11	54.9	0.0081
6/20/2011	**BPC5**	13:53	7.04	1235	11.79	TOLLWAY 940	<0.037	<0.11	0.092	0.0582	<0.00055	109	<0.012	<0.013	<0.0058	<0.00079	0.038	3.47	<0.11	50.5	0.0083
7/27/2011	**BPC5**	11:23	7.06	1223	11.81	TOLLWAY 1008	<0.037	<0.11	0.070	0.0498	<0.00055	114	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.71	<0.11	54.9	<0.0015
8/24/2011	**BPC5**	14:26	7.09	1200	12.73	TOLLWAY 1071	<0.037	<0.11	0.087	0.0583	<0.00055	111	<0.012	<0.013	<0.0058	0.00095	<0.024	3.74	<0.11	52.3	<0.0015
9/28/2011	**BPC5**	12:34	7.16	1205	11.19	TOLLWAY 1164	<0.037	<0.11	0.091	0.0568	<0.00055	111	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.32	<0.11	52.9	<0.0015
11/9/2011	**BPC5**	13:45	7.04	1208	9.97	TOLLWAY 1215	<0.037	<0.11	0.092	0.0579	<0.00055	111	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.38	<0.11	51.8	0.0055
12/7/2011	**BPC5**	15:50	7.30	1205	9.27	TOLLWAY 1285	<0.037	<0.11	0.105	0.0573	<0.00055	113	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.25	<0.11	51.7	<0.0015
1/11/2012	**BPC5**	15:10	7.47	1193	10.21	TOLLWAY 1344	<0.037	<0.11	0.098	0.0598	<0.00055	109	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.75	<0.11	51.0	<0.0015
2/22/2012	**BPC5**	15:49	7.46	1201	10.02	TOLLWAY 1429	<0.037	<0.11	0.092	0.0566	<0.00055	112	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.25	<0.11	51.7	<0.0015
3/27/2012	**BPC5**	12:24	7.10	1171	11.39	TOLLWAY 1525	<0.037	<0.11	0.114	0.0602	<0.00055	115	<0.012	<0.013	<0.0058	<0.00079	0.038	3.46	<0.11	55.4	0.0039
5/1/2012	**BPC5**	11:30	7.13	1208	10.92	TOLLWAY 1583	<0.037	<0.11	0.097	0.0614	<0.00055	121	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.04	<0.11	56.5	0.0024
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	0	11	11	0	11	0	0	0	1	3	11	0	11	5
						% Detects	0	0	100	100	0	100	0	0	0	9	27	100	0	100	45
		min	7.02	1171	9.27	min	-	-	0.070	0.0498	-	109	-	-	-	0.00095	0.037	3.04	-	50.5	0.0024
		max	7.47	1235	12.73	max	-	-	0.114	0.0614	-	121	-	-	-	0.00095	0.038	3.75	-	56.5	0.0083
		mean	7.17	1207	10.9	mean	-	-	0.094	0.0577	-	113	-	-	-	0.00095	0.038	3.44	-	53.1	0.0057
		range	0.45	64	3.46	range	-	-	0.044	0.0116	-	12	-	-	-	-	0.001	0.71	-	6.0	0.0059
5/19/2011	**BPC6**	8:36	8.06	1813	14.67	TOLLWAY 886	<0.037	<0.11	0.070	0.0634	<0.00055	74.0	<0.012	<0.013	<0.0058	0.00119	0.050	3.12	<0.11	36.6	0.0618
6/20/2011	**BPC6**	15:12	8.06	812	23.67	TOLLWAY 942	<0.037	<0.11	0.044	0.0322	<0.00055	37.0	<0.012	<0.013	<0.0058	0.00216	0.071	2.45	<0.11	15.1	0.0177
7/27/2011	**BPC6**	12:50	8.10	835	25.73	TOLLWAY 1011	<0.037	<0.11	0.023	0.0243	<0.00055	35.5	<0.012	<0.013	<0.0058	<0.00079	0.040	2.91	<0.11	14.1	<0.0015
8/24/2011	**BPC6**	15:39	7.99	786	26.43	TOLLWAY 1073	<0.037	<0.11	0.045	0.0358	<0.00055	38.5	<0.012	<0.013	<0.0058	0.00168	0.055	3.35	<0.11	16.2	0.0123
9/28/2011	**BPC6**	13:39	8.19	806	16.14	TOLLWAY 1166	<0.037	<0.11	0.045	0.0325	<0.00055	37.0	<0.012	<0.013	<0.0058	0.00112	0.045	3.26	<0.11	15.8	0.0096
11/9/2011	**BPC6**	15:01	7.72	849	9.76	TOLLWAY 1217	0.132	<0.11	0.055	0.0354	<0.00055	41.2	<0.012	<0.013	<0.0058	0.00207	0.231	3.64	<0.11	18.3	0.0167
12/7/2011	**BPC6**	12:37	7.53	1045	3.35	TOLLWAY 1278	<0.037	<0.11	0.054	0.0450	<0.00055	60.5	<0.012	<0.013	<0.0058	0.00114	<0.024	3.30	<0.11	25.0	0.0154
1/11/2012	**BPC6**	12:05	7.97	1339	3.07	TOLLWAY 1337	<0.037	<0.11	0.066	0.0588	<0.00055	74.9	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.37	<0.11	32.5	0.0205
2/22/2012	**BPC6**	12:52	8.19	2363	4.39	TOLLWAY 1424	<0.037	<0.11	0.055	0.0737	<0.00055	94.4	<0.012	<0.013	<0.0058	0.00103	<0.024	3.78	<0.11	38.5	0.0255
3/27/2012	**BPC6**	13:08	8.42	2171	12.85	TOLLWAY 1526	<0.037	<0.11	0.065	0.0648	<0.00055	81.7	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.54	<0.11	35.5	0.0278
5/1/2012	**BPC6**	8:30	8.00	1610	12.61	TOLLWAY 1575	<0.037	<0.11	0.054	0.0540	<0.00055	58.2	<0.012	<0.013	<0.0058	<0.00079	0.045	2.96	<0.11	29.6	0.0227
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	1	0	11	11	0	11	0	0	0	7	7	11	0	11	10
						% Detects	9	0	100	100	0	100	0	0	0	64	64	100	0	100	91
		min	7.53	786	3.07	min	0.132	-	0.023	0.0243	-	35.5	-	-	-	0.00103	0.040	2.45	-	14.1	0.0096
		max	8.42	2363	26.43	max	0.132	-	0.070	0.0737	-	94.4	-	-	-	0.00216	0.231	3.78	-	38.5	0.0618
		mean	8.02	1312	13.9	mean	0.132	-	0.052	0.0473	-	57.5	-	-	-	0.00148	0.077	3.24	-	25.2	0.023
		range	0.89	1577	23.36	range	-	-	0.047	0.0493	-	59.0	-	-	-	0.00113	0.191	1.34	-	24.4	0.0522
6/20/2011	**BPC7**	16:25	7.80	1157	22.01	TOLLWAY 944	<0.037	<0.11	0.042	0.0347	<0.00055	33.6	<0.012	<0.013	<0.0058	0.00138	0.119	6.23	<0.11	15.3	0.0132
7/27/2011	**BPC7**	14:45	7.67	899	24.13	TOLLWAY 1014	<0.037	<0.11	<0.023	0.0252	<0.00055	38.4	<0.012	<0.013	<0.0058	<0.00079	0.047	5.14	<0.11	15.0	<0.0015
8/24/2011	**BPC7**	17:23	7.63	1078	24.70	TOLLWAY 1077	0.339	<0.11	0.036	0.0410	<0.00055	36.4	<0.012	<0.013	<0.0058	0.00154	0.047	8.26	<0.11	12.3	<0.0015
9/28/2011	**BPC7**	15:03	7.86	1078	15.03	TOLLWAY 1169	<0.037	<0.11	0.029	0.0358	<0.00055	32.5	<0.012	<0.013	<0.0058	0.00122	0.047	7.53	<0.11	12.2	0.0016
11/9/2011	**BPC7**	16:29	7.76	1143	8.78	TOLLWAY 1220	0.042	<0.11	0.032	0.0408	<0.00055	40.3	<0.012	<0.013	<0.0058	0.00125	0.054	8.80	<0.11	13.9	0.0029
12/7/2011	**BPC7**	13:40	7.30	1520	2.84	TOLLWAY 1280	<0.037	<0.11	0.029	0.0610	<0.00055	70.0	<0.012	<0.013	<0.0058	<0.00079	<0.024	6.90	<0.11	29.6	0.0032
2/22/2012	**BPC7**	14:24	7.78	2702	4.28	TOLLWAY 1426	<0.037	<0.11	0.029	0.102	<0.00055	122	<0.012	<0.013	<0.0058	<0.00079	<0.024	6.80	<0.11	51.6	0.0019
3/27/2012	**BPC7**	14:26	7.54	3385	12.04	TOLLWAY 1529	<0.037	<0.11	0.040	0.126	<0.00055	122	<0.012	<0.013	<0.0058	<0.00079	<0.024	8.88	<0.11	50.0	0.0140
5/1/2012	**BPC7**	9:49	7.64	2940	11.62	TOLLWAY 1579	<0.037	<0.11	0.037	0.0876	<0.00055	77.6	<0.012	<0.013	<0.0058	<0.00079	0.060	9.62	<0.11	33.1	0.0085
						samples analyzed	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
						detects	2	0	8	9	0	9	0	0	0	4	6	9	0	9	7
						% Detects	22	0	89	100	0	100	0	0	0	44	67	100	0	100	78
		min	7.30	899	2.84	min	0.042	-	0.029	0.0252	-	32.5	-	-	-	0.00122	0.047	5.14	-	12.2	0.0016
		max	7.86	3385	24.70	max	0.339	-	0.042	0.1256	-	122.1	-	-	-	0.00154	0.119	9.62	-	51.6	0.0140
		mean	7.66	1767	13.9	mean	0.19	-	0.034	0.0615	-	63.6	-	-	-	0.00135	0.062	7.57	-	25.9	0.0065
		range	0.56	2486	21.86	range	0.297	-	0.014	0.1004	-	89.5	-	-	-	0.00032	0.072	4.49	-	39.4	0.0124

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn
							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
						MDL:	0.037	0.11	0.023	0.00085	0.00055	0.029	0.012	0.013	0.0058	0.00079	0.024	0.016	0.11	0.027	0.0015
5/19/2011	**ISGS1**	10:50	7.91	2330	14.82	TOLLWAY 889	<0.037	<0.11	0.038	0.0404	<0.00055	60.6	<0.012	<0.013	<0.0058	0.00087	0.088	3.49	<0.11	30.6	0.0433
6/20/2011	**ISGS1**	17:07	9.08	520	25.19	TOLLWAY 946	<0.037	<0.11	<0.023	0.0101	<0.00055	18.4	<0.012	<0.013	<0.0058	0.00080	0.093	1.32	<0.11	7.19	0.0094
7/27/2011	**ISGS1**	15:08	7.51	478	25.82	TOLLWAY 1015	<0.037	<0.11	<0.023	0.0173	<0.00055	26.0	<0.012	<0.013	<0.0058	<0.00079	0.139	1.93	<0.11	8.36	0.0198
8/24/2011	**ISGS1**	17:51	7.68	348	28.28	TOLLWAY 1078	<0.037	<0.11	<0.023	0.0202	<0.00055	20.0	<0.012	<0.013	<0.0058	<0.00079	0.113	1.19	<0.11	6.17	0.0110
9/28/2011	**ISGS1**	15:24	7.87	316	16.34	TOLLWAY 1167	<0.037	<0.11	<0.023	0.0179	<0.00055	19.6	<0.012	<0.013	<0.0058	<0.00079	0.052	1.00	<0.11	6.33	0.0086
11/9/2011	**ISGS1**	15:42	7.75	298	10.00	TOLLWAY 1218	0.098	<0.11	<0.023	0.0122	<0.00055	18.9	<0.012	<0.013	<0.0058	<0.00079	0.103	0.979	<0.11	6.49	0.0116
12/7/2011	**ISGS1**	13:19	7.41	448	4.22	TOLLWAY 1279	<0.037	<0.11	<0.023	0.0147	<0.00055	26.7	<0.012	<0.013	<0.0058	<0.00079	0.034	1.27	<0.11	9.97	0.0090
1/11/2012	**ISGS1**	13:32	7.94	772	4.54	TOLLWAY 1341	<0.037	<0.11	<0.023	0.0179	<0.00055	34.7	<0.012	<0.013	<0.0058	<0.00079	0.046	1.63	<0.11	14.0	0.0120
2/22/2012	**ISGS1**	15:02	7.86	3278	5.56	TOLLWAY 1428	<0.037	<0.11	<0.023	0.0484	<0.00055	75.0	<0.012	<0.013	<0.0058	<0.00079	<0.024	2.97	<0.11	27.2	0.0327
3/27/2012	**ISGS1**	14:48	7.45	3258	13.67	TOLLWAY 1530	<0.037	<0.11	0.026	0.0375	<0.00055	73.9	<0.012	<0.013	<0.0058	<0.00079	0.100	3.12	<0.11	29.7	0.0343
5/1/2012	**ISGS1**	10:12	8.85	1222	13.81	TOLLWAY 1580	<0.037	<0.11	<0.023	0.0132	<0.00055	27.0	<0.012	<0.013	<0.0058	<0.00079	0.038	1.50	<0.11	13.7	0.0098
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	1	0	2	11	0	11	0	0	0	2	10	11	0	11	11
						% Detects	9	0	18	100	0	100	0	0	0	18	91	100	0	100	100
		min	7.41	298	4.22	min	0.098	-	0.026	0.0101	-	18.4	-	-	-	0.00080	0.034	0.979	-	6.17	0.0086
		max	9.08	3278	28.28	max	0.098	-	0.038	0.0484	-	75.0	-	-	-	0.00087	0.139	3.49	-	30.62	0.0433
		mean	7.94	1206	14.8	mean	0.098	-	0.032	0.0227	-	36.4	-	-	-	0.00083	0.081	1.85	-	14.5	0.018
		range	1.67	2980	24.06	range	-	-	0.012	0.0383	-	56.6	-	-	-	0.00007	0.104	2.51	-	24.46	0.0348
5/19/2011	**ISGS2**	10:03	7.99	1250	17.22	TOLLWAY 887	<0.037	<0.11	0.032	0.0335	<0.00055	50.5	<0.012	<0.013	<0.0058	0.00081	<0.024	2.12	<0.11	22.2	0.0058
6/20/2011	**ISGS2**	16:42	8.74	506	25.88	TOLLWAY 945	<0.037	<0.11	0.031	0.0191	<0.00055	28.4	<0.012	<0.013	<0.0058	<0.00079	0.058	2.10	<0.11	11.0	0.0084
7/27/2011	**ISGS2**	14:30	7.90	400	28.07	TOLLWAY 1013	<0.037	<0.11	<0.023	0.00790	<0.00055	23.5	<0.012	<0.013	<0.0058	<0.00079	<0.024	2.17	<0.11	9.02	<0.0015
8/24/2011	**ISGS2**	17:07	8.42	474	28.58	TOLLWAY 1076	<0.037	<0.11	0.025	0.0189	<0.00055	26.0	<0.012	<0.013	<0.0058	0.00082	0.063	2.21	<0.11	10.4	0.0050
9/28/2011	**ISGS2**	14:50	8.10	503	16.73	TOLLWAY 1168	<0.037	<0.11	0.028	0.0227	<0.00055	28.7	<0.012	<0.013	<0.0058	<0.00079	0.026	1.94	<0.11	11.1	0.0048
11/9/2011	**ISGS2**	16:13	7.79	288	9.53	TOLLWAY 1219	<0.037	<0.11	<0.023	0.0193	<0.00055	30.7	<0.012	<0.013	<0.0058	<0.00079	<0.024	1.84	<0.11	11.3	0.0060
12/7/2011	**ISGS2**	13:59	8.14	534	4.21	TOLLWAY 1281	<0.037	<0.11	0.026	0.0220	<0.00055	34.9	<0.012	<0.013	<0.0058	<0.00079	0.028	2.09	<0.11	12.3	0.0041
1/11/2012	**ISGS2**	13:12	8.54	621	5.17	TOLLWAY 1340	<0.037	<0.11	0.031	0.0246	<0.00055	40.1	<0.012	<0.013	<0.0058	<0.00079	<0.024	2.20	<0.11	16.0	<0.0015
2/22/2012	**ISGS2**	14:37	8.14	1253	5.84	TOLLWAY 1427	<0.037	<0.11	0.027	0.0372	<0.00055	56.3	<0.012	<0.013	<0.0058	0.00482	<0.024	2.09	<0.11	21.8	0.0031
3/27/2012	**ISGS2**	14:10	8.29	1718	15.37	TOLLWAY 1528	<0.037	<0.11	0.035	0.0442	<0.00055	65.2	<0.012	<0.013	<0.0058	<0.00079	0.061	2.22	<0.11	27.7	0.0131
5/1/2012	**ISGS2**	9:34	8.51	1435	13.86	TOLLWAY 1578	<0.037	<0.11	0.032	0.0328	<0.00055	42.7	<0.012	<0.013	<0.0058	<0.00079	<0.024	1.79	<0.11	23.0	0.0071
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	0	9	11	0	11	0	0	0	3	5	11	0	11	9
						% Detects	0	0	82	100	0	100	0	0	0	27	45	100	0	100	82
		min	7.79	288	4.21	min	-	-	0.025	0.00790	-	23.5	-	-	-	0.00081	0.026	1.79	-	9.02	0.0031
		max	8.74	1718	28.58	max	-	-	0.035	0.04420	-	65.2	-	-	-	0.00482	0.063	2.22	-	27.71	0.0131
		mean	8.23	817	15.5	mean	-	-	0.030	0.0257	-	38.8	-	-	-	0.0021	0.047	2.07	-	16.0	0.0064
		range	0.95	1430	24.37	range	-	-	0.010	0.0363	-	41.7	-	-	-	0.00401	0.037	0.43	-	18.70	0.0100

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	Tl	V	Zn
							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
						MDL:	0.022	0.026	0.043	0.073	0.041	0.22	0.059	0.13	0.066	0.086	0.00037	0.00056	0.017	0.047	0.0097
5/18/2011	**BPC1**	13:40	8.08	nr	11.78	TOLLWAY 882	<0.022	215.6	<0.043	0.135	0.042	28.6	<0.059	<0.13	2.86	<0.086	0.242	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**BPC1**	13:21	7.90	693	21.72	TOLLWAY 938	<0.022	98.6	<0.043	0.155	<0.041	8.22	<0.059	<0.13	1.81	<0.086	0.0837	<0.00056	<0.017	<0.047	<0.0097
7/27/2011	**BPC1**	10:50	7.84	902	22.03	TOLLWAY 1007	<0.022	115.9	<0.043	0.121	<0.041	14.0	<0.059	<0.13	2.06	<0.086	0.125	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC1**	13:43	7.85	829	23.19	TOLLWAY 1069	<0.022	94.1	<0.043	0.148	<0.041	12.8	<0.059	<0.13	2.18	<0.086	0.118	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC1**	12:01	7.96	856	15.37	TOLLWAY 1162	<0.022	105.3	<0.043	0.202	<0.041	16.0	<0.059	<0.13	2.05	<0.086	0.128	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**BPC1**	13:11	7.58	838	10.20	TOLLWAY 1213	<0.022	97.6	<0.043	0.161	<0.041	14.0	<0.059	<0.13	1.48	<0.086	0.0965	<0.00056	<0.017	<0.047	<0.0097
12/7/2011	**BPC1**	16:23	8.01	1091	3.87	TOLLWAY 1286	<0.022	104.7	<0.043	0.144	<0.041	22.0	<0.059	<0.13	2.22	<0.086	0.161	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**BPC1**	14:16	8.10	1284	5.79	TOLLWAY 1342	<0.022	127.4	<0.043	0.105	<0.041	26.5	<0.059	<0.13	1.81	<0.086	0.205	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC1**	16:36	8.34	2178	5.54	TOLLWAY 1432	<0.022	276.2	<0.043	0.152	<0.041	29.3	<0.059	<0.13	1.43	<0.086	0.246	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC1**	11:21	8.24	1998	10.75	TOLLWAY 1522	<0.022	264.4	<0.043	0.179	<0.041	28.6	<0.059	<0.13	1.86	<0.086	0.258	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC1**	10:45	8.02	1571	12.66	TOLLWAY 1581	<0.022	215.5	<0.043	0.180	<0.041	23.5	<0.059	<0.13	1.79	<0.086	0.219	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	1	11	0	0	11	0	11	0	0	0	0
						% Detects	0	100	0	100	9	100	0	0	100	0	100	0	0	0	0
		min	7.58	693	3.87	min	-	94.1	-	0.105	0.042	8.22	-	-	1.43	-	0.0837	-	-	-	-
		max	8.34	2178	23.19	max	-	276.2	-	0.202	0.042	29.28	-	-	2.86	-	0.2580	-	-	-	-
		mean	7.99	1224	13.0	mean	-	156	-	0.153	0.042	20.3	-	-	1.96	-	0.171	-	-	-	-
		range	0.76	1485	19.32	range	-	182.1	-	0.097	-	21.06	-	-	1.43	-	0.1743	-	-	-	-
5/18/2011	**BPC2**	16:08	7.59	1710	12.19	TOLLWAY 885	<0.022	209	<0.043	0.140	<0.041	27.0	<0.059	<0.13	2.60	<0.086	0.239	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**BPC2**	14:19	8.01	747	22.07	TOLLWAY 941	<0.022	98.1	<0.043	0.174	<0.041	8.92	<0.059	<0.13	1.92	<0.086	0.0894	0.00096	<0.017	<0.047	<0.0097
7/27/2011	**BPC2**	12:03	7.87	883	22.79	TOLLWAY 1010	<0.022	114	<0.043	0.081	<0.041	13.8	<0.059	<0.13	1.97	<0.086	0.125	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC2**	14:54	7.97	819	23.91	TOLLWAY 1072	<0.022	95.4	<0.043	0.151	<0.041	12.6	<0.059	<0.13	2.15	<0.086	0.120	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC2**	12:58	8.00	840	15.48	TOLLWAY 1165	<0.022	98.5	<0.043	0.199	<0.041	15.4	<0.059	<0.13	1.95	<0.086	0.124	0.00189	<0.017	<0.047	<0.0097
11/9/2011	**BPC2**	14:17	7.85	845	9.87	TOLLWAY 1216	<0.022	101	<0.043	0.139	<0.041	14.0	<0.059	<0.13	1.46	<0.086	0.0972	0.00068	<0.017	<0.047	<0.0097
12/7/2011	**BPC2**	15:14	7.85	1075	4.15	TOLLWAY 1283	<0.022	104	<0.043	0.126	<0.041	21.8	<0.059	<0.13	2.18	<0.086	0.164	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**BPC2**	14:46	7.90	1258	6.45	TOLLWAY 1343	<0.022	124	<0.043	0.131	<0.041	25.8	<0.059	<0.13	1.99	<0.086	0.201	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC2**	16:15	8.18	2188	5.44	TOLLWAY 1431	<0.022	276	<0.043	0.142	<0.041	29.1	<0.059	<0.13	1.48	<0.086	0.244	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC2**	12:01	8.00	1991	11.20	TOLLWAY 1524	<0.022	264	<0.043	0.159	<0.041	28.4	<0.059	<0.13	1.88	<0.086	0.260	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC2**	11:07	7.92	1568	12.70	TOLLWAY 1582	<0.022	216	<0.043	0.189	<0.041	23.3	<0.059	<0.13	1.67	<0.086	0.218	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	0	11	0	0	11	0	11	3	0	0	0
						% Detects	0	100	0	100	0	100	0	0	100	0	100	27	0	0	0
		min	7.59	747	4.15	min	-	95.4	-	0.081	-	8.92	-	-	1.46	-	0.0894	0.00068	-	-	-
		max	8.18	2188	23.91	max	-	275.8	-	0.199	-	29.11	-	-	2.60	-	0.2605	0.00189	-	-	-
		mean	7.92	1266	13.3	mean	-	155	-	0.15	-	20.0	-	-	1.93	-	0.171	0.0012	-	-	-
		range	0.59	1441	19.76	range	-	180.5	-	0.118	-	20.19	-	-	1.14	-	0.1710	0.00122	-	-	-
5/19/2011	**BPC3**	10:24	8.24	1810	15.59	TOLLWAY 888	<0.022	247	<0.043	0.168	<0.041	23.8	<0.059	<0.13	0.765	<0.086	0.175	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**BPC3**	16:00	8.04	828	23.75	TOLLWAY 943	<0.022	106	<0.043	0.210	<0.041	9.78	<0.059	<0.13	1.90	<0.086	0.0885	<0.00056	<0.017	<0.047	<0.0097
7/27/2011	**BPC3**	14:07	8.10	783	26.59	TOLLWAY 1012	<0.022	108	<0.043	0.083	<0.041	10.9	<0.059	<0.13	1.39	<0.086	0.0907	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC3**	16:44	7.97	776	26.53	TOLLWAY 1075	<0.022	91.6	<0.043	0.084	<0.041	11.5	<0.059	<0.13	1.77	<0.086	0.103	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC3**	15:24	8.26	641	16.33	TOLLWAY 1170	<0.022	78.4	<0.043	0.427	<0.041	11.2	<0.059	<0.13	1.75	<0.086	0.105	0.00507	<0.017	<0.047	0.0264
11/9/2011	**BPC3**	16:50	7.83	352	9.50	TOLLWAY 1221	<0.022	95.4	<0.043	0.251	<0.041	14.2	<0.059	<0.13	1.79	<0.086	0.0899	0.00292	<0.017	<0.047	<0.0097
12/7/2011	**BPC3**	14:21	7.65	1067	3.64	TOLLWAY 1282	<0.022	120	<0.043	0.132	<0.041	19.4	<0.059	<0.13	1.88	<0.086	0.121	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**BPC3**	12:49	8.19	1397	4.33	TOLLWAY 1339	<0.022	158	<0.043	0.120	<0.041	24.2	<0.059	<0.13	1.19	<0.086	0.148	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC3**	14:02	8.39	2264	5.06	TOLLWAY 1425	<0.022	292	<0.043	0.132	<0.041	26.1	<0.059	<0.13	1.27	<0.086	0.194	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC3**	13:49	8.41	2094	14.26	TOLLWAY 1527	<0.022	303	<0.043	0.148	<0.041	24.9	<0.059	<0.13	0.495	<0.086	0.205	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC3**	9:12	8.19	1581	13.09	TOLLWAY 1577	<0.022	224	<0.043	0.145	<0.041	21.4	<0.059	<0.13	0.774	<0.086	0.176	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	0	11	0	0	11	0	11	2	0	0	1
						% Detects	0	100	0	100	0	100	0	0	100	0	100	18	0	0	9
		min	7.65	352	3.64	min	-	78.4	-	0.083	-	9.78	-	-	0.495	-	0.0885	0.00292	-	-	0.0264
		max	8.41	2264	26.59	max	-	302.7	-	0.427	-	26.08	-	-	1.896	-	0.2054	0.00507	-	-	0.0264
		mean	8.12	1236	14.4	mean	-	166	-	0.17	-	17.9	-	-	1.36	-	0.136	0.00400	-	-	0.0264
		range	0.76	1912	22.95	range	-	224.3	-	0.344	-	16.30	-	-	1.401	-	0.1170	0.00214	-	-	-

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	Tl	V	Zn
							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
						MDL:	0.022	0.026	0.043	0.073	0.041	0.22	0.059	0.13	0.066	0.086	0.00037	0.00056	0.017	0.047	0.0097
5/18/2011	**BPC5**	15:06	7.02	1228	10.94	TOLLWAY 884	<0.022	76.6	<0.043	0.137	<0.041	34.2	<0.059	<0.13	6.70	<0.086	0.412	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**BPC5**	13:53	7.04	1235	11.79	TOLLWAY 940	<0.022	81.0	<0.043	0.175	<0.041	32.7	<0.059	<0.13	6.56	<0.086	0.401	<0.00056	<0.017	<0.047	<0.0097
7/27/2011	**BPC5**	11:23	7.06	1223	11.81	TOLLWAY 1008	<0.022	80.5	<0.043	0.129	<0.041	33.0	<0.059	<0.13	6.79	<0.086	0.440	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC5**	14:26	7.09	1200	12.73	TOLLWAY 1071	<0.022	74.8	<0.043	0.119	<0.041	34.3	<0.059	<0.13	6.68	<0.086	0.412	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC5**	12:34	7.16	1205	11.19	TOLLWAY 1164	<0.022	71.3	<0.043	0.159	<0.041	36.7	<0.059	<0.13	6.63	<0.086	0.397	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**BPC5**	13:45	7.04	1208	9.97	TOLLWAY 1215	<0.022	71.1	<0.043	0.147	<0.041	36.9	<0.059	<0.13	6.34	<0.086	0.376	<0.00056	<0.017	<0.047	<0.0097
12/7/2011	**BPC5**	15:50	7.30	1205	9.27	TOLLWAY 1285	<0.022	66.8	<0.043	0.135	<0.041	35.9	<0.059	<0.13	6.33	<0.086	0.397	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**BPC5**	15:10	7.47	1193	10.21	TOLLWAY 1344	<0.022	75.1	<0.043	0.168	<0.041	35.4	<0.059	<0.13	6.46	<0.086	0.398	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC5**	15:49	7.46	1201	10.02	TOLLWAY 1429	<0.022	64.0	<0.043	0.156	<0.041	37.7	<0.059	<0.13	6.38	<0.086	0.395	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC5**	12:24	7.10	1171	11.39	TOLLWAY 1525	<0.022	70.7	<0.043	0.127	<0.041	39.6	<0.059	<0.13	6.88	<0.086	0.440	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC5**	11:30	7.13	1208	10.92	TOLLWAY 1583	<0.022	68.1	<0.043	0.141	<0.041	39.8	<0.059	<0.13	6.75	<0.086	0.448	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	0	11	0	0	11	0	11	0	0	0	0
						% Detects	0	100	0	100	0	100	0	0	100	0	100	0	0	0	0
		min	7.02	1171	9.27	min	-	64.0	-	0.119	-	32.7	-	-	6.33	-	0.376	-	-	-	-
		max	7.47	1235	12.73	max	-	81.0	-	0.175	-	39.8	-	-	6.88	-	0.448	-	-	-	-
		mean	7.17	1207	10.9	mean	-	72.7	-	0.145	-	36.0	-	-	6.59	-	0.411	-	-	-	-
		range	0.45	64	3.46	range	-	16.9	-	0.057	-	7.1	-	-	0.55	-	0.072	-	-	-	-
5/19/2011	**BPC6**	8:36	8.06	1813	14.67	TOLLWAY 886	<0.022	252	<0.043	0.131	<0.041	22.8	<0.059	<0.13	0.746	<0.086	0.176	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**BPC6**	15:12	8.06	812	23.67	TOLLWAY 942	<0.022	109	<0.043	0.177	<0.041	9.26	<0.059	<0.13	1.67	<0.086	0.0879	<0.00056	<0.017	<0.047	<0.0097
7/27/2011	**BPC6**	12:50	8.10	835	25.73	TOLLWAY 1011	<0.022	119	<0.043	0.118	<0.041	10.8	<0.059	<0.13	1.29	<0.086	0.0937	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC6**	15:39	7.99	786	26.43	TOLLWAY 1073	<0.022	102	<0.043	0.104	<0.041	11.1	<0.059	<0.13	1.78	<0.086	0.103	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC6**	13:39	8.19	806	16.14	TOLLWAY 1166	<0.022	107	<0.043	0.187	<0.041	13.1	<0.059	<0.13	1.40	<0.086	0.106	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**BPC6**	15:01	7.72	849	9.76	TOLLWAY 1217	<0.022	102	<0.043	0.169	<0.041	13.7	<0.059	<0.13	1.53	<0.086	0.0902	0.00385	<0.017	<0.047	<0.0097
12/7/2011	**BPC6**	12:37	7.53	1045	3.35	TOLLWAY 1278	<0.022	119	<0.043	0.151	<0.041	18.7	<0.059	<0.13	1.68	<0.086	0.118	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**BPC6**	12:05	7.97	1339	3.07	TOLLWAY 1337	<0.022	150	<0.043	0.077	<0.041	22.9	<0.059	<0.13	0.839	<0.086	0.142	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC6**	12:52	8.19	2363	4.39	TOLLWAY 1424	<0.022	317	<0.043	0.109	<0.041	26.6	<0.059	<0.13	0.985	<0.086	0.213	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC6**	13:08	8.42	2171	12.85	TOLLWAY 1526	<0.022	319	<0.043	0.169	<0.041	25.2	<0.059	<0.13	0.379	<0.086	0.211	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC6**	8:30	8.00	1610	12.61	TOLLWAY 1575	<0.022	234	<0.043	0.168	<0.041	21.1	<0.059	<0.13	0.782	<0.086	0.182	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	0	11	0	0	11	0	11	1	0	0	0
						% Detects	0	100	0	100	0	100	0	0	100	0	100	9	0	0	0
		min	7.53	786	3.07	min	-	102	-	0.077	-	9.26	-	-	0.379	-	0.0879	0.00385	-	-	-
		max	8.42	2363	26.43	max	-	319	-	0.187	-	26.59	-	-	1.778	-	0.2132	0.00385	-	-	-
		mean	8.02	1312	13.9	mean	-	175	-	0.14	-	17.7	-	-	1.19	-	0.139	0.00385	-	-	-
		range	0.89	1577	23.36	range	-	217	-	0.110	-	17.34	-	-	1.399	-	0.1252	-	-	-	-
6/20/2011	**BPC7**	16:25	7.80	1157	22.01	TOLLWAY 944	<0.022	181	<0.043	0.175	<0.041	8.45	<0.059	<0.13	1.60	<0.086	0.112	0.00089	<0.017	<0.047	<0.0097
7/27/2011	**BPC7**	14:45	7.67	899	24.13	TOLLWAY 1014	<0.022	129	<0.043	0.108	<0.041	9.00	<0.059	<0.13	2.55	<0.086	0.118	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**BPC7**	17:23	7.63	1078	24.70	TOLLWAY 1077	<0.022	161	<0.043	0.173	<0.041	6.82	<0.059	<0.13	1.46	<0.086	0.130	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**BPC7**	15:03	7.86	1078	15.03	TOLLWAY 1169	<0.022	171	<0.043	0.136	<0.041	9.40	<0.059	<0.13	1.14	<0.086	0.116	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**BPC7**	16:29	7.76	1143	8.78	TOLLWAY 1220	<0.022	158	<0.043	0.122	<0.041	13.2	<0.059	<0.13	1.66	<0.086	0.122	0.00114	<0.017	<0.047	<0.0097
12/7/2011	**BPC7**	13:40	7.30	1520	2.84	TOLLWAY 1280	<0.022	190	<0.043	0.091	<0.041	17.7	<0.059	<0.13	2.51	<0.086	0.181	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**BPC7**	14:24	7.78	2702	4.28	TOLLWAY 1426	<0.022	331	<0.043	0.129	<0.041	27.9	<0.059	<0.13	1.98	<0.086	0.316	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**BPC7**	14:26	7.54	3385	12.04	TOLLWAY 1529	<0.022	518	<0.043	0.170	<0.041	23.9	<0.059	<0.13	1.85	<0.086	0.410	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**BPC7**	9:49	7.64	2940	11.62	TOLLWAY 1579	<0.022	494	<0.043	0.156	<0.041	18.7	<0.059	<0.13	1.27	<0.086	0.324	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
						detects	0	9	0	9	0	9	0	0	9	0	9	2	0	0	0
						% Detects	0	100	0	100	0	100	0	0	100	0	100	22	0	0	0
		min	7.30	899	2.84	min	-	129	-	0.091	-	6.82	-	-	1.14	-	0.112	0.00089	-	-	-
		max	7.86	3385	24.70	max	-	518	-	0.175	-	27.93	-	-	2.55	-	0.410	0.00114	-	-	-
		mean	7.66	1767	13.9	mean	-	259	-	0.14	-	15.0	-	-	1.78	-	0.203	0.0010	-	-	-
		range	0.56	2486	21.86	range	-	389	-	0.084	-	21.11	-	-	1.40	-	0.298	0.00025	-	-	-

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	Mo mg/L	Na mg/L	Ni mg/L	P mg/L	Pb mg/L	S mg/L	Sb mg/L	Se mg/L	Si mg/L	Sn mg/L	Sr mg/L	Ti mg/L	Tl mg/L	V mg/L	Zn mg/L
						MDL:	0.022	0.026	0.043	0.073	0.041	0.22	0.059	0.13	0.066	0.086	0.00037	0.00056	0.017	0.047	0.0097
5/19/2011	**ISGS1**	10:50	7.91	2330	14.82	TOLLWAY 889	<0.022	383	<0.043	0.119	<0.041	20.0	<0.059	<0.13	0.395	<0.086	0.238	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**ISGS1**	17:07	9.08	520	25.19	TOLLWAY 946	<0.022	78.3	<0.043	0.130	<0.041	5.89	<0.059	<0.13	0.429	<0.086	0.0670	0.00062	<0.017	<0.047	<0.0097
7/27/2011	**ISGS1**	15:08	7.51	478	25.82	TOLLWAY 1015	<0.022	58.9	<0.043	0.112	<0.041	7.34	<0.059	<0.13	0.760	<0.086	0.0757	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**ISGS1**	17:51	7.68	348	28.28	TOLLWAY 1078	<0.022	38.9	<0.043	<0.073	<0.041	5.04	<0.059	<0.13	0.746	<0.086	0.0559	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**ISGS1**	15:24	7.87	316	16.34	TOLLWAY 1167	<0.022	34.3	<0.043	0.125	<0.041	4.88	<0.059	<0.13	0.318	<0.086	0.0459	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**ISGS1**	15:42	7.75	298	10.00	TOLLWAY 1218	<0.022	30.0	<0.043	0.099	<0.041	5.23	<0.059	<0.13	0.653	<0.086	0.0375	0.00218	<0.017	<0.047	<0.0097
12/7/2011	**ISGS1**	13:19	7.41	448	4.22	TOLLWAY 1279	<0.022	48.3	<0.043	0.097	<0.041	7.06	<0.059	<0.13	0.337	<0.086	0.0556	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**ISGS1**	13:32	7.94	772	4.54	TOLLWAY 1341	<0.022	100	<0.043	0.139	<0.041	8.28	<0.059	<0.13	0.371	<0.086	0.0836	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**ISGS1**	15:02	7.86	3278	5.56	TOLLWAY 1428	<0.022	529	<0.043	0.132	<0.041	16.8	<0.059	<0.13	0.538	<0.086	0.307	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**ISGS1**	14:48	7.45	3258	13.67	TOLLWAY 1530	<0.022	566	<0.043	0.095	<0.041	19.2	<0.059	<0.13	0.505	<0.086	0.358	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**ISGS1**	10:12	8.85	1222	13.81	TOLLWAY 1580	<0.022	204	<0.043	0.125	<0.041	10.1	<0.059	<0.13	0.620	<0.086	0.145	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	10	0	11	0	0	11	0	11	2	0	0	0
						% Detects	0	100	0	91	0	100	0	0	100	0	100	18	0	0	0
		min	7.41	298	4.22	min	-	30.0	-	0.095	-	4.88	-	-	0.318	-	0.0375	0.00062	-	-	-
		max	9.08	3278	28.28	max	-	565.8	-	0.139	-	19.96	-	-	0.760	-	0.3576	0.00218	-	-	-
		mean	7.94	1206	14.8	mean	-	188	-	0.12	-	9.98	-	-	0.516	-	0.134	0.0014	-	-	-
		range	1.67	2980	24.06	range	-	535.8	-	0.044	-	15.08	-	-	0.442	-	0.3201	0.00156	-	-	-
5/19/2011	**ISGS2**	10:03	7.99	1250	17.22	TOLLWAY 887	<0.022	167	<0.043	0.117	<0.041	19.7	<0.059	<0.13	0.489	<0.086	0.112	<0.00056	<0.017	<0.047	<0.0097
6/20/2011	**ISGS2**	16:42	8.74	506	25.88	TOLLWAY 945	<0.022	59.2	<0.043	0.126	<0.041	8.56	<0.059	<0.13	0.403	<0.086	0.0566	<0.00056	<0.017	<0.047	<0.0097
7/27/2011	**ISGS2**	14:30	7.90	400	28.07	TOLLWAY 1013	<0.022	42.2	<0.043	0.077	<0.041	6.61	<0.059	<0.13	0.463	<0.086	0.0485	<0.00056	<0.017	<0.047	<0.0097
8/24/2011	**ISGS2**	17:07	8.42	474	28.58	TOLLWAY 1076	<0.022	51.3	<0.043	0.159	<0.041	8.73	<0.059	<0.13	1.31	<0.086	0.0543	<0.00056	<0.017	<0.047	<0.0097
9/28/2011	**ISGS2**	14:50	8.10	503	16.73	TOLLWAY 1168	<0.022	55.5	<0.043	0.099	<0.041	9.32	<0.059	<0.13	0.836	<0.086	0.0583	<0.00056	<0.017	<0.047	<0.0097
11/9/2011	**ISGS2**	16:13	7.79	288	9.53	TOLLWAY 1219	<0.022	50.1	<0.043	0.134	<0.041	10.7	<0.059	<0.13	0.521	<0.086	0.0510	<0.00056	<0.017	<0.047	<0.0097
12/7/2011	**ISGS2**	13:59	8.14	534	4.21	TOLLWAY 1281	<0.022	53.9	<0.043	0.145	<0.041	12.2	<0.059	<0.13	0.213	<0.086	0.0622	<0.00056	<0.017	<0.047	<0.0097
1/11/2012	**ISGS2**	13:12	8.54	621	5.17	TOLLWAY 1340	<0.022	67.4	<0.043	0.141	<0.041	14.7	<0.059	<0.13	0.142	<0.086	0.0674	<0.00056	<0.017	<0.047	<0.0097
2/22/2012	**ISGS2**	14:37	8.14	1253	5.84	TOLLWAY 1427	<0.022	157	<0.043	0.135	<0.041	19.9	<0.059	0.16	0.463	<0.086	0.102	<0.00056	<0.017	<0.047	<0.0097
3/27/2012	**ISGS2**	14:10	8.29	1718	15.37	TOLLWAY 1528	<0.022	247	<0.043	0.179	<0.041	24.9	<0.059	<0.13	0.287	<0.086	0.149	<0.00056	<0.017	<0.047	<0.0097
5/1/2012	**ISGS2**	9:34	8.51	1435	13.86	TOLLWAY 1578	<0.022	216	<0.043	0.152	<0.041	20.2	<0.059	<0.13	0.085	<0.086	0.119	<0.00056	<0.017	<0.047	<0.0097
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
						detects	0	11	0	11	0	11	0	1	11	0	11	0	0	0	0
						% Detects	0	100	0	100	0	100	0	9	100	0	100	0	0	0	0
		min	7.79	288	4.21	min	-	42.2	-	0.077	-	6.61	-	0.16	0.085	-	0.0485	-	-	-	-
		max	8.74	1718	28.58	max	-	247.2	-	0.179	-	24.89	-	0.16	1.315	-	0.1485	-	-	-	-
		mean	8.23	817	15.5	mean	-	106	-	0.13	-	14.1	-	0.16	0.47	-	0.0800	-	-	-	-
		range	0.95	1430	24.37	range	-	205.0	-	0.102	-	18.27	-	-	1.229	-	0.1001	-	-	-	-

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	pH	alkalinity mg/L as $CaCO_3$	TDS, 180 C mg/L	TSS mg/L	oPO_4-P mg/L	NH_3-N mg/L	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	total NVOC mg/L	dissolved NVOC mg/L
						MDL:		4	12	3.0	0.003	0.03	0.08	0.09/0.16*	0.07/0.04**	0.31	0.31	0.31
5/18/2011	**BPC1**	13:40	8.08	nr	11.78	TOLLWAY 882	8.09	253	990	<3.0	0.011	0.16	0.20	346	0.33	76.4	3.87	4.11
6/20/2011	**BPC1**	13:21	7.90	693	21.72	TOLLWAY 938	7.95	107	401	39.2	0.031	<0.03	0.15	133	0.23	23.1	9.90	7.10
7/27/2011	**BPC1**	10:50	7.84	902	22.03	TOLLWAY 1007	8.09	139	492	5.6	0.013	<0.03	0.20	164	0.20	37.6	6.06	5.13
8/24/2011	**BPC1**	13:43	7.85	829	23.19	TOLLWAY 1069	8.11	144	461	5.6	0.013	<0.03	0.19	149	0.21	36.6	7.16	6.54
9/28/2011	**BPC1**	12:01	7.96	856	15.37	TOLLWAY 1162	8.18	141	465	6.0	0.016	<0.03	0.18	156	0.25	41.1	8.00	6.12
11/9/2011	**BPC1**	13:11	7.58	838	10.20	TOLLWAY 1213	7.98	141	458	15.2	0.017	<0.03	0.20	152	0.30	39.7	8.38	6.48
12/7/2011	**BPC1**	16:23	8.01	1091	3.87	TOLLWAY 1286	8.10	218	605	<3.0	0.006	<0.03	0.20	177	0.19	66.7	4.30	5.10
1/11/2012	**BPC1**	14:16	8.10	1284	5.79	TOLLWAY 1342	8.25	249	706	<3.0	<0.003	<0.03	0.18	216	0.09	83.1	3.56	3.42
2/22/2012	**BPC1**	16:36	8.34	2178	5.54	TOLLWAY 1432	8.24	222	1137	<3.0	0.008	<0.03	0.26	496	<0.07	81.9	2.71	2.59
3/27/2012	**BPC1**	11:21	8.24	1998	10.75	TOLLWAY 1522	8.21	227	1163	<3.0	0.006	<0.03	0.20	470	0.09	78.1	3.65	3.73
5/1/2012	**BPC1**	10:45	8.02	1571	12.66	TOLLWAY 1581	8.14	180	876	<3.0	0.021	<0.03	0.27	356	0.19	66.1	6.03	5.51
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	5	10	1	11	11	10	11	11	11
						% Detects	0	100	100	45	91	9	100	100	91	100	100	100
		min	7.58	693	3.87	min	7.95	107	401	5.6	0.006	0.16	0.15	133	0.09	23.1	2.71	2.59
		max	8.34	2178	23.19	max	8.25	253	1163	39.2	0.031	0.16	0.27	496	0.33	83.1	9.90	7.10
		mean	7.99	1224	13.0	mean	8.12	184	705	14	0.01	0.16	0.20	256	0.2	57.3	5.78	5.08
		range	0.76	1485	19.32	range	0.31	146	762	33.6	0.025	0.00	0.12	363	0.24	60.0	7.19	4.51
5/18/2011	**BPC2**	16:08	7.59	1710	12.19	TOLLWAY 885	8.03	249	967	<3.0	0.011	0.15	0.20	344	0.32	75.8	4.19	4.29
6/20/2011	**BPC2**	14:19	8.01	747	22.07	TOLLWAY 941	7.98	115	403	28.4	0.017	<0.03	0.13	142	0.21	24.9	9.42	6.95
7/27/2011	**BPC2**	12:03	7.87	883	22.79	TOLLWAY 1010	8.04	135	477	6.0	0.013	<0.03	0.20	163	0.18	37.0	6.15	5.36
8/24/2011	**BPC2**	14:54	7.97	819	23.91	TOLLWAY 1072	8.11	141	448	6.0	0.012	<0.03	0.19	147	0.20	35.9	7.12	6.43
9/28/2011	**BPC2**	12:58	8.00	840	15.48	TOLLWAY 1165	8.17	137	452	7.6	0.018	<0.03	0.18	154	0.24	40.3	8.04	5.99
11/9/2011	**BPC2**	14:17	7.85	845	9.87	TOLLWAY 1216	8.02	141	455	12.8	0.016	<0.03	0.19	153	0.31	40.3	8.16	6.30
12/7/2011	**BPC2**	15:14	7.85	1075	4.15	TOLLWAY 1283	8.06	214	586	<3.0	0.007	<0.03	0.18	174	0.19	66.2	4.40	4.09
1/11/2012	**BPC2**	14:46	7.90	1258	6.45	TOLLWAY 1343	8.06	246	704	<3.0	0.003	<0.03	0.17	214	0.14	82.7	3.52	3.36
2/22/2012	**BPC2**	16:15	8.18	2188	5.44	TOLLWAY 1431	8.20	219	1135	<3.0	0.009	<0.03	0.26	501	0.08	81.8	3.01	2.87
3/27/2012	**BPC2**	12:01	8.00	1991	11.20	TOLLWAY 1524	8.05	225	1171	<3.0	0.007	<0.03	0.21	471	0.11	77.5	3.95	3.79
5/1/2012	**BPC2**	11:07	7.92	1568	12.70	TOLLWAY 1582	8.07	179	877	<3.0	0.022	<0.03	0.25	354	0.18	65.7	6.54	5.79
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	5	11	1	11	11	11	11	11	11
						% Detects	0	100	100	45	100	9	100	100	100	100	100	100
		min	7.59	747	4.15	min	7.98	115	403	6.0	0.003	0.15	0.13	142	0.08	24.9	3.01	2.87
		max	8.18	2188	23.91	max	8.20	249	1171	28.4	0.022	0.15	0.26	501	0.32	82.7	9.42	6.95
		mean	7.92	1266	13.3	mean	8.07	182	698	12	0.01	0.15	0.20	256	0.2	57.1	5.86	5.02
		range	0.59	1441	19.76	range	0.22	134	768	22.4	0.019	0.00	0.13	359	0.24	57.8	6.41	4.08
5/19/2011	**BPC3**	10:24	8.24	1810	15.59	TOLLWAY 888	8.28	203	961	3.2	0.011	0.04	0.20	401	0.18	65.1	5.95	5.93
6/20/2011	**BPC3**	16:00	8.04	828	23.75	TOLLWAY 943	8.10	132	450	19.6	0.014	<0.03	0.14	159	0.17	27.6	9.94	7.05
7/27/2011	**BPC3**	14:07	8.10	783	26.59	TOLLWAY 1012	8.25	108	417	12.0	0.012	0.03	0.21	152	0.07	30.0	8.20	6.43
8/24/2011	**BPC3**	16:44	7.97	776	26.53	TOLLWAY 1075	8.20	128	421	12.0	0.012	<0.03	0.19	142	0.08	32.7	8.31	7.18
9/28/2011	**BPC3**	15:24	8.26	641	16.33	TOLLWAY 1170	8.16	105	339	47.6	0.163	0.04	0.21	112	0.21	31.0	13.2	6.71
11/9/2011	**BPC3**	16:50	7.83	352	9.50	TOLLWAY 1221	7.99	140	450	21.2	0.043	0.05	0.21	144	0.43	40.0	9.76	6.94
12/7/2011	**BPC3**	14:21	7.65	1067	3.64	TOLLWAY 1282	8.31	196	589	<3.0	0.009	<0.03	0.19	187	0.37	59.7	5.78	5.21
1/11/2012	**BPC3**	12:49	8.19	1397	4.33	TOLLWAY 1339	8.40	229	799	3.6	<0.003	<0.03	0.17	266	0.27	75.0	5.12	4.66
2/22/2012	**BPC3**	14:02	8.39	2264	5.06	TOLLWAY 1425	8.48	220	1182	<3.0	0.012	<0.03	0.28	534	0.22	75.2	3.84	3.41
3/27/2012	**BPC3**	13:49	8.41	2094	14.26	TOLLWAY 1527	8.57	197	1171	<3.0	0.004	<0.03	0.22	530	<0.04	68.6	4.59	4.95
5/1/2012	**BPC3**	9:12	8.19	1581	13.09	TOLLWAY 1577	8.25	156	918	4.0	0.019	<0.03	0.28	377	0.12	62.0	7.40	6.49
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	8	10	4	11	11	10	11	11	11
						% Detects	0	100	100	73	91	36	100	100	91	100	100	100
		min	7.65	352	3.64	min	7.99	105	339	3.2	0.004	0.03	0.14	112	0.07	27.6	3.84	3.41
		max	8.41	2264	26.59	max	8.57	229	1182	47.6	0.163	0.05	0.28	534	0.43	75.2	13.25	7.18
		mean	8.12	1236	14.4	mean	8.27	165	700	15	0.03	0.04	0.21	273	0.2	51.5	7.47	5.90
		range	0.76	1912	22.95	range	0.58	123	843	44.4	0.159	0.02	0.14	422	0.36	47.6	9.41	3.77

*MDL for Cl updated to 0.16 mg/L beginning 2/22/2012. **MDL for NO3 -N updated to 0.04 beginning 3/8/2012.

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	pH	alkalinity mg/L as $CaCO_3$	TDS, 180 C mg/L	TSS mg/L	oPO_4-P mg/L	NH_3-N mg/L	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	total NVOC mg/L	dissolved NVOC mg/L
						MDL:		4	12	3.0	0.003	0.03	0.08	0.09/0.16*	0.07/0.04**	0.31	0.31	0.31
5/18/2011	**BPC5**	15:06	7.02	1228	10.94	TOLLWAY 884	7.44	337	706	<3.0	0.013	0.06	0.21	149	0.19	94.6	1.15	1.24
6/20/2011	**BPC5**	13:53	7.04	1235	11.79	TOLLWAY 940	7.39	342	696	<3.0	0.005	<0.03	0.21	141	0.17	94.1	1.71	1.43
7/27/2011	**BPC5**	11:23	7.06	1223	11.81	TOLLWAY 1008	7.45	342	719	<3.0	0.015	<0.03	0.25	134	0.14	91.9	1.15	1.14
8/24/2011	**BPC5**	14:26	7.09	1200	12.73	TOLLWAY 1071	7.50	343	718	<3.0	0.016	<0.03	0.25	136	0.11	98.6	1.28	1.22
9/28/2011	**BPC5**	12:34	7.16	1205	11.19	TOLLWAY 1164	7.77	343	701	<3.0	0.011	<0.03	0.21	135	0.10	101	1.39	1.35
11/9/2011	**BPC5**	13:45	7.04	1208	9.97	TOLLWAY 1215	7.34	342	707	<3.0	0.011	<0.03	0.25	133	<0.07	107	1.36	1.33
12/7/2011	**BPC5**	15:50	7.30	1205	9.27	TOLLWAY 1285	7.42	339	691	<3.0	0.011	<0.03	0.21	132	<0.07	109	1.32	1.08
1/11/2012	**BPC5**	15:10	7.47	1193	10.21	TOLLWAY 1344	7.41	341	724	<3.0	0.011	<0.03	0.22	130	<0.07	110	1.15	1.10
2/22/2012	**BPC5**	15:49	7.46	1201	10.02	TOLLWAY 1429	7.39	342	702	<3.0	0.020	<0.03	0.20	129	0.10	110	0.52	0.48
3/27/2012	**BPC5**	12:24	7.10	1171	11.39	TOLLWAY 1525	7.38	341	714	<3.0	0.014	<0.03	0.21	132	0.12	109	0.90	1.10
5/1/2012	**BPC5**	11:30	7.13	1208	10.92	TOLLWAY 1583	7.48	340	797	<3.0	0.014	<0.03	0.25	145	0.13	108	1.22	1.28
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	0	11	1	11	11	8	11	11	11
						% Detects	0	100	100	0	100	9	100	100	73	100	100	100
		min	7.02	1171	9.27	min	7.34	337	691	-	0.005	0.06	0.20	129	0.10	91.9	0.52	0.48
		max	7.47	1235	12.73	max	7.77	343	797	-	0.020	0.06	0.25	149	0.19	110.5	1.71	1.43
		mean	7.17	1207	10.9	mean	7.45	341	716	-	0.01	0.06	0.23	136	0.13	103	1.2	1.2
		range	0.45	64	3.46	range	0.43	6	106	-	0.015	-	0.05	20	0.09	18.5	1.19	0.95
5/19/2011	**BPC6**	8:36	8.06	1813	14.67	TOLLWAY 886	8.16	204	1007	13.6	0.012	0.34	0.17	418	0.43	63.5	6.21	5.84
6/20/2011	**BPC6**	15:12	8.06	812	23.67	TOLLWAY 942	8.08	121	465	18.8	0.015	<0.03	0.15	159	0.19	25.9	9.24	7.14
7/27/2011	**BPC6**	12:50	8.10	835	25.73	TOLLWAY 1011	8.18	108	446	9.2	0.013	<0.03	0.21	168	0.09	29.2	7.57	6.37
8/24/2011	**BPC6**	15:39	7.99	786	26.43	TOLLWAY 1073	8.20	123	428	11.6	0.010	0.06	0.18	150	0.13	30.8	8.04	7.05
9/28/2011	**BPC6**	13:39	8.19	806	16.14	TOLLWAY 1166	8.21	118	430	15.6	0.022	0.07	0.18	155	0.22	35.6	9.24	6.43
11/9/2011	**BPC6**	15:01	7.72	849	9.76	TOLLWAY 1217	7.99	137	463	15.6	0.021	0.06	0.20	156	0.32	39.3	8.63	6.71
12/7/2011	**BPC6**	12:37	7.53	1045	3.35	TOLLWAY 1278	8.34	192	565	<3.0	0.008	<0.03	0.17	183	0.31	56.8	5.52	4.99
1/11/2012	**BPC6**	12:05	7.97	1339	3.07	TOLLWAY 1337	8.34	219	720	<3.0	<0.003	<0.03	0.16	252	0.26	70.1	4.90	4.60
2/22/2012	**BPC6**	12:52	8.19	2363	4.39	TOLLWAY 1424	8.47	213	1228	<3.0	0.009	<0.03	0.27	574	0.19	74.3	3.75	3.58
3/27/2012	**BPC6**	13:08	8.42	2171	12.85	TOLLWAY 1526	8.49	190	1200	<3.0	0.005	<0.03	0.20	551	<0.04	68.1	5.39	4.85
5/1/2012	**BPC6**	8:30	8.00	1610	12.61	TOLLWAY 1575	8.15	153	940	3.2	0.016	<0.03	0.26	389	0.17	59.5	7.38	6.79
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	7	10	4	11	11	10	11	11	11
						% Detects	0	100	100	64	91	36	100	100	91	100	100	100
		min	7.53	786	3.07	min	7.99	108	428	3.2	0.005	0.06	0.15	150	0.09	25.9	3.75	3.58
		max	8.42	2363	26.43	max	8.49	219	1228	18.8	0.022	0.34	0.27	574	0.43	74.3	9.24	7.14
		mean	8.02	1312	13.9	mean	8.24	162	717	13	0.01	0.1	0.20	287	0.2	50.3	6.90	5.85
		range	0.89	1577	23.36	range	0.50	112	800	15.6	0.017	0.28	0.12	423	0.34	48.5	5.49	3.56
6/20/2011	**BPC7**	16:25	7.80	1157	22.01	TOLLWAY 944	7.98	117	656	7.6	0.010	<0.03	0.12	267	0.08	22.9	10.5	9.01
7/27/2011	**BPC7**	14:45	7.67	899	24.13	TOLLWAY 1014	8.03	146	481	22.4	0.027	<0.03	0.20	173	0.10	24.7	7.44	6.75
8/24/2011	**BPC7**	17:23	7.63	1078	24.70	TOLLWAY 1077	7.93	131	562	3.2	0.012	<0.03	0.17	237	<0.07	19.0	8.32	8.52
9/28/2011	**BPC7**	15:03	7.86	1078	15.03	TOLLWAY 1169	8.08	112	560	<3.0	0.013	<0.03	0.16	250	0.09	25.4	8.95	7.49
11/9/2011	**BPC7**	16:29	7.76	1143	8.78	TOLLWAY 1220	7.84	128	607	3.6	0.014	<0.03	0.21	251	0.09	38.8	9.45	8.26
12/7/2011	**BPC7**	13:40	7.30	1520	2.84	TOLLWAY 1280	7.67	216	803	<3.0	0.007	<0.03	0.15	311	<0.07	55.3	5.21	4.96
2/22/2012	**BPC7**	14:24	7.78	2702	4.28	TOLLWAY 1426	7.86	248	1384	<3.0	0.012	<0.03	0.25	658	<0.07	80.0	3.33	3.38
3/27/2012	**BPC7**	14:26	7.54	3385	12.04	TOLLWAY 1529	7.87	214	1896	<3.0	0.008	<0.03	0.18	951	<0.04	63.6	4.89	4.66
5/1/2012	**BPC7**	9:49	7.64	2940	11.62	TOLLWAY 1579	7.83	130	1651	<3.0	0.007	<0.03	0.30	841	0.05	52.2	8.82	8.83
						samples analyzed	9	9	9	9	9	9	9	9	9	9	9	9
						detects		9	9	4	9	0	9	9	5	9	9	9
						% Detects	0	100	100	44	100	0	100	100	56	100	100	100
		min	7.30	899	2.84	min	7.67	112	481	3.2	0.007	-	0.12	173	0.05	19.0	3.33	3.38
		max	7.86	3385	24.70	max	8.08	248	1896	22.4	0.027	-	0.30	951	0.10	80.0	10.53	9.01
		mean	7.66	1767	13.9	mean	7.90	160	956	9.2	0.01	-	0.19	438	0.08	42.4	7.44	6.87
		range	0.56	2486	21.86	range	0.41	136	1415	19.2	0.020	-	0.19	778	0.05	61.0	7.19	5.63

*MDL for Cl updated to 0.16 mg/L beginning 2/22/2012. **MDL for NO3 -N updated to 0.04 beginning 3/8/2012.

APPENDIX B: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by ISGS from May 2011-May 2012

Date collected	Sample location	Time collected (CST)	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Sample ID	pH	alkalinity mg/L as $CaCO_3$	TDS, 180 C mg/L	TSS mg/L	oPO_4-P mg/L	NH_3-N mg/L	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	total NVOC mg/L	dissolved NVOC mg/L
						MDL:		4	12	3.0	0.003	0.03	0.08	0.09/0.16*	0.07/0.04**	0.31	0.31	0.31
5/19/2011	**ISGS1**	10:50	7.91	2330	14.82	TOLLWAY 889	7.96	111	1223	<3.0	<0.003	0.20	0.10	610	<0.07	52.3	7.36	6.83
6/20/2011	**ISGS1**	17:07	9.08	520	25.19	TOLLWAY 946	8.85	50	301	3.6	<0.003	<0.03	0.09	113	0.15	16.6	6.83	5.53
7/27/2011	**ISGS1**	15:08	7.51	478	25.82	TOLLWAY 1015	7.71	73	267	<3.0	0.011	0.13	0.13	86.4	0.14	20.3	5.83	4.97
8/24/2011	**ISGS1**	17:51	7.68	348	28.28	TOLLWAY 1078	7.29	58	184	<3.0	0.004	0.09	0.09	60.8	0.17	13.9	5.72	5.49
9/28/2011	**ISGS1**	15:24	7.87	316	16.34	TOLLWAY 1167	7.52	59	167	<3.0	<0.003	0.05	0.13	50.7	0.19	13.7	4.97	3.90
11/9/2011	**ISGS1**	15:42	7.75	298	10.00	TOLLWAY 1218	7.09	60	160	<3.0	0.003	<0.03	0.12	44.8	0.28	15.3	4.71	4.24
12/7/2011	**ISGS1**	13:19	7.41	448	4.22	TOLLWAY 1279	7.15	87	234	<3.0	<0.003	<0.03	0.16	70.4	0.11	21.8	3.90	3.73
1/11/2012	**ISGS1**	13:32	7.94	772	4.54	TOLLWAY 1341	7.43	97	397	<3.0	<0.003	<0.03	0.16	161	<0.07	25.6	4.11	3.57
2/22/2012	**ISGS1**	15:02	7.86	3278	5.56	TOLLWAY 1428	7.53	114	1687	<3.0	0.007	<0.03	0.20	929	0.09	47.2	3.72	3.25
3/27/2012	**ISGS1**	14:48	7.45	3258	13.67	TOLLWAY 1530	7.71	111	1789	<3.0	<0.003	<0.03	0.12	963	<0.04	51.1	5.35	4.91
5/1/2012	**ISGS1**	10:12	8.85	1222	13.81	TOLLWAY 1580	8.57	54	668	<3.0	<0.003	<0.03	0.14	325	0.91	28.3	7.67	6.57
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	1	4	4	11	11	8	11	11	11
						% Detects	0	100	100	9	36	36	100	100	73	100	100	100
		min	7.41	298	4.22	min	7.09	50	160	3.6	0.003	0.05	0.09	44.8	0.09	13.7	3.72	3.25
		max	9.08	3278	28.28	max	8.85	114	1789	3.6	0.011	0.20	0.20	962.6	0.91	52.3	7.67	6.83
		mean	7.94	1206	14.8	mean	7.71	79	643	3.6	0.006	0.1	0.1	310	0.3	27.8	5.47	4.82
		range	1.67	2980	24.06	range	1.77	64	1629	0.0	0.008	0.15	0.11	917.8	0.82	38.6	3.95	3.58
5/19/2011	**ISGS2**	10:03	7.99	1250	17.22	TOLLWAY 887	8.12	129	674	<3.0	<0.003	4.22	0.09	263	2.52	54.9	5.74	5.65
6/20/2011	**ISGS2**	16:42	8.74	506	25.88	TOLLWAY 945	8.55	91	283	4.8	<0.003	0.05	0.10	82.6	0.47	24.5	8.13	5.97
7/27/2011	**ISGS2**	14:30	7.90	400	28.07	TOLLWAY 1013	8.00	78	215	7.2	<0.003	0.36	0.15	60.4	0.43	18.0	7.36	5.48
8/24/2011	**ISGS2**	17:07	8.42	474	28.58	TOLLWAY 1076	8.44	89	259	6.8	<0.003	0.42	0.12	75.7	0.23	25.3	7.66	7.11
9/28/2011	**ISGS2**	14:50	8.10	503	16.73	TOLLWAY 1168	8.11	97	271	4.8	<0.003	0.31	0.12	79.4	0.25	26.1	8.16	5.98
11/9/2011	**ISGS2**	16:13	7.79	288	9.53	TOLLWAY 1219	7.77	96	267	3.2	0.005	0.12	0.10	71.1	0.56	31.0	6.11	5.19
12/7/2011	**ISGS2**	13:59	8.14	534	4.21	TOLLWAY 1281	8.36	109	286	<3.0	<0.003	<0.03	0.13	74.2	0.56	38.0	4.92	4.60
1/11/2012	**ISGS2**	13:12	8.54	621	5.17	TOLLWAY 1340	8.46	120	338	<3.0	<0.003	<0.03	0.13	91.2	0.63	46.0	4.73	4.27
2/22/2012	**ISGS2**	14:37	8.14	1253	5.84	TOLLWAY 1427	8.08	142	656	<3.0	0.007	<0.03	0.17	269	0.51	56.9	3.63	3.54
3/27/2012	**ISGS2**	14:10	8.29	1718	15.37	TOLLWAY 1528	8.31	146	952	<3.0	<0.003	<0.03	0.15	420	0.15	68.3	4.84	4.56
5/1/2012	**ISGS2**	9:34	8.51	1435	13.86	TOLLWAY 1578	8.42	102	806	<3.0	0.003	<0.03	0.19	355	<0.04	58.4	6.66	6.09
						samples analyzed	11	11	11	11	11	11	11	11	11	11	11	11
						detects		11	11	5	3	6	11	11	10	11	11	11
						% Detects	0	100	100	45	27	55	100	100	91	100	100	100
		min	7.79	288	4.21	min	7.77	78	215	3.2	0.003	0.05	0.09	60.4	0.15	18.0	3.63	3.54
		max	8.74	1718	28.58	max	8.55	146	952	7.2	0.007	4.22	0.19	420.3	2.52	68.3	8.16	7.11
		mean	8.23	817	15.5	mean	8.24	109	455	5.4	0.005	0.9	0.1	167	0.63	40.7	6.18	5.31
		range	0.95	1430	24.37	range	0.78	68	737	4.0	0.003	4.17	0.10	359.9	2.37	50.3	4.54	3.57

*MDL for Cl updated to 0.16 mg/L beginning 2/22/2012. **MDL for NO3 -N updated to 0.04 beginning 3/8/2012.

APPENDIX C: Results of Geochemical Analysis of ISGS Field Duplicate Samples

			Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na
		Sample ID	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date collected	Sample location	MDL:	0.037	0.11	0.023	0.00085	0.00055	0.029	0.012	0.013	0.0058	0.00079	0.024	0.016	0.11	0.027	0.0015	0.022	0.026
5/18/2011	BPC1	TOLLWAY 882	<0.037	<0.11	0.076	0.0648	<0.00055	93.5	<0.012	<0.013	<0.0058	0.00091	0.027	3.74	<0.11	43.5	0.0184	<0.022	215.6
5/18/2011	BPC1_duplicate	TOLLWAY 883	<0.037	<0.11	0.076	0.0640	<0.00055	91.3	<0.012	<0.013	<0.0058	0.00081	0.028	3.74	<0.11	42.7	0.0182	<0.022	213
		difference	-	-	0.00029	0.000817	-	2.19	-	-	-	0.000095	0.0014	0.00402	-	0.828	0.000279	-	3.04
		% difference	-	-	0.39	1.26	-	2.34	-	-	-	10.48	5.19	0.11	-	1.90	1.51	-	1.41
6/20/2011	BPC1	TOLLWAY 938	<0.037	<0.11	0.039	0.0284	<0.00055	32.5	<0.012	<0.013	<0.0058	0.00300	0.062	2.35	<0.11	12.5	0.0058	<0.022	98.6
6/20/2011	BPC1_duplicate	TOLLWAY 939	<0.037	<0.11	0.037	0.0278	<0.00055	31.6	<0.012	<0.013	<0.0058	0.00267	0.076	2.29	<0.11	12.3	0.0060	<0.022	95.7
		difference	-	-	0.0017	0.000639	-	0.915	-	-	-	0.000325	0.013	0.0568	-	0.216	0.00026	-	2.88
		% difference	-	-	4.24	2.25	-	2.82	-	-	-	10.83	21.10	2.42	-	1.73	4.59	-	2.92
7/27/2011	BPC5	TOLLWAY 1008	<0.037	<0.11	0.070	0.0498	<0.00055	114	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.71	<0.11	54.9	<0.0015	<0.022	80.5
7/27/2011	BPC5_duplicate	TOLLWAY 1009	<0.037	<0.11	0.070	0.0498	<0.00055	115	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.66	<0.11	54.8	<0.0015	<0.022	79.2
		difference	-	-	0.00067	0.0000701	-	1.58	-	-	-	-	-	0.0416	-	0.166	-	-	1.32
		% difference	-	-	0.97	0.14	-	1.39	-	-	-	-	-	1.12	-	0.30	-	-	1.63
8/24/2011	BPC1	TOLLWAY 1069	<0.037	<0.11	0.050	0.0378	<0.00055	43.9	<0.012	<0.013	<0.0058	0.00169	0.037	3.30	<0.11	18.7	0.0050	<0.022	94.1
8/24/2011	BPC1_duplicate	TOLLWAY 1070	<0.037	<0.11	0.049	0.0379	<0.00055	44.1	<0.012	<0.013	<0.0058	0.00142	0.037	3.31	<0.11	18.8	0.0047	<0.022	94.5
		difference	-	-	0.00097	0.000154	-	0.244	-	-	-	0.000264	0.00069	0.0128	-	0.122	0.00023	-	0.457
		% difference	-	-	1.95	0.41	-	0.56	-	-	-	15.67	1.86	0.39	-	0.65	4.62	-	0.49
9/28/2011	BPC1	TOLLWAY 1162	<0.037	<0.11	0.052	0.0367	<0.00055	47.7	<0.012	<0.013	<0.0058	<0.00079	0.058	3.24	<0.11	20.6	0.0065	<0.022	105.3
9/28/2011	BPC1_duplicate	TOLLWAY 1163	<0.037	<0.11	0.050	0.0355	<0.00055	45.5	<0.012	<0.013	<0.0058	0.00184	0.060	3.17	<0.11	19.9	0.0054	<0.022	98.0
		difference	-	-	0.0023	0.00121	-	2.24	-	-	-	-	0.0014	0.0696	-	0.691	0.0011	-	7.29
		% difference	-	-	4.49	3.30	-	4.69	-	-	-	-	2.44	2.15	-	3.35	17.08	-	6.93
11/9/2011	BPC1	TOLLWAY 1213	<0.037	<0.11	0.053	0.0353	<0.00055	43.1	<0.012	<0.013	<0.0058	0.00109	0.032	3.51	<0.11	19.3	0.0065	<0.022	97.6
11/9/2011	BPC1_duplicate	TOLLWAY 1214	<0.037	<0.11	0.057	0.0349	<0.00055	43.2	<0.012	<0.013	<0.0058	0.00083	0.027	3.54	<0.11	19.4	0.0065	<0.022	97.7
		difference	-	-	0.0046	0.000454	-	0.0531	-	-	-	0.00026	0.0051	0.0314	-	0.0615	0.000023	-	0.142
		% difference	-	-	8.81	1.29	-	0.12	-	-	-	23.50	15.75	0.89	-	0.32	0.35	-	0.15
12/7/2011	BPC2	TOLLWAY 1283	<0.037	<0.11	0.070	0.0451	<0.00055	71.6	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.06	<0.11	29.4	0.0056	<0.022	104
12/7/2011	BPC2_duplicate	TOLLWAY 1284	<0.037	<0.11	0.068	0.0452	<0.00055	70.8	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.07	<0.11	29.2	0.0053	<0.022	104
		difference	-	-	0.0021	0.000111	-	0.754	-	-	-	-	-	0.0121	-	0.183	0.00022	-	0.105
		% difference	-	-	2.95	0.25	-	1.05	-	-	-	-	-	0.40	-	0.62	3.92	-	0.10
1/11/2012	BPC6	TOLLWAY 1337	<0.037	<0.11	0.066	0.0588	<0.00055	74.9	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.37	<0.11	32.5	0.0205	<0.022	150
1/11/2012	BPC6_duplicate	TOLLWAY 1338	<0.037	<0.11	0.064	0.0591	<0.00055	75.8	<0.012	<0.013	<0.0058	0.00158	<0.024	3.52	<0.11	32.8	0.0200	<0.022	153
		difference	-	-	0.0016	0.000296	-	0.911	-	-	-	-	-	0.153	-	0.334	0.000535	-	3.01
		% difference	-	-	2.49	0.50	-	1.22	-	-	-	-	-	4.54	-	1.03	2.60	-	2.01
2/22/2012	BPC5	TOLLWAY 1429	<0.037	<0.11	0.092	0.0566	<0.00055	112	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.25	<0.11	51.7	<0.0015	<0.022	64.0
2/22/2012	BPC5_duplicate	TOLLWAY 1430	<0.037	<0.11	0.091	0.0548	<0.00055	110	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.17	<0.11	50.7	<0.0015	<0.022	62.4
		difference	-	-	0.00093	0.00174	-	2.09	-	-	-	-	-	0.0752	-	0.948	-	-	1.63
		% difference	-	-	1.01	3.08	-	1.87	-	-	-	-	-	2.31	-	1.83	-	-	2.55
3/27/2012	BPC1	TOLLWAY 1522	<0.037	<0.11	0.072	0.0669	<0.00055	92.1	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.73	<0.11	43.5	0.0083	<0.022	264.4
3/27/2012	BPC1_duplicate	TOLLWAY 1523	<0.037	<0.11	0.077	0.0682	<0.00055	93.8	<0.012	<0.013	<0.0058	<0.00079	<0.024	3.79	<0.11	44.9	0.0088	<0.022	269
		difference	-	-	0.0049	0.00127	-	1.71	-	-	-	-	-	0.0584	-	1.43	0.00052	-	5.12
		% difference	-	-	6.74	1.89	-	1.86	-	-	-	-	-	1.56	-	3.27	6.31	-	1.94
5/1/2012	BPC6	TOLLWAY 1575	<0.037	<0.11	0.054	0.0540	<0.00055	58.2	<0.012	<0.013	<0.0058	<0.00079	0.045	2.96	<0.11	29.6	0.0227	<0.022	234
5/1/2012	BPC6_duplicate	TOLLWAY 1576	<0.037	<0.11	0.053	0.0539	<0.00055	57.4	<0.012	<0.013	<0.0058	<0.00079	0.025	2.96	<0.11	28.9	0.0219	<0.022	235
		difference	-	-	0.0013	0.000121	-	0.779	-	-	-	-	0.020	0.000228	-	0.716	0.000855	-	0.862
		% difference	-	-	2.33	0.22	-	1.34	-	-	-	-	44.38	0.01	-	2.42	3.76	-	0.37

>20% Relative Percent Difference

APPENDIX C: Results of Geochemical Analysis of ISGS Field Duplicate Samples

			Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	oPO_4-P
		Sample ID	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L
Date collected	Sample location	MDL:	0.043	0.073	0.041	0.22	0.059	0.13	0.066	0.086	0.00037	0.00056	0.017	0.047	0.0097		4	12	0.003
5/18/2011	BPC1	TOLLWAY 882	<0.043	0.135	0.042	28.6	<0.059	<0.13	2.86	<0.086	0.242	<0.00056	<0.017	<0.047	<0.0097	8.09	253	990	0.011
5/18/2011	BPC1_duplicate	TOLLWAY 883	<0.043	0.084	<0.041	28.1	<0.059	<0.13	2.82	<0.086	0.240	<0.00056	<0.017	<0.047	<0.0097	8.13	253	1001	0.011
		difference	-	0.051	-	0.467	-	-	0.0451	-	0.00191	-	-	-	-	0.03300	0.0320	11.0	0.000085
		% difference	-	37.76	-	1.63	-	-	1.58	-	0.79	-	-	-	-	0.41	0.01	1.11	0.75
6/20/2011	BPC1	TOLLWAY 938	<0.043	0.155	<0.041	8.22	<0.059	<0.13	1.81	<0.086	0.0837	<0.00056	<0.017	<0.047	<0.0097	7.95	107	401	0.031
6/20/2011	BPC1_duplicate	TOLLWAY 939	<0.043	0.177	<0.041	7.98	<0.059	<0.13	1.79	<0.086	0.0818	0.00065	<0.017	<0.047	<0.0097	7.95	106	393	0.031
		difference	-	0.0220	-	0.236	-	-	0.0209	-	0.00185	-	-	-	-	0.00300	0.755	8.00	0.000036
		% difference	-	14.20	-	2.87	-	-	1.15	-	2.21	-	-	-	-	0.04	0.71	2.00	0.12
7/27/2011	BPC5	TOLLWAY 1008	<0.043	0.129	<0.041	33.0	<0.059	<0.13	6.79	<0.086	0.440	<0.00056	<0.017	<0.047	<0.0097	7.45	342	719	0.015
7/27/2011	BPC5_duplicate	TOLLWAY 1009	<0.043	0.133	<0.041	33.7	<0.059	<0.13	6.83	<0.086	0.439	<0.00056	<0.017	<0.047	<0.0097	7.45	342	752	0.014
		difference	-	0.00348	-	0.697	-	-	0.0399	-	0.000845	-	-	-	-	0.00600	0.0860	33.0	0.00049
		% difference	-	2.69	-	2.11	-	-	0.59	-	0.19	-	-	-	-	0.08	0.03	4.59	3.30
8/24/2011	BPC1	TOLLWAY 1069	<0.043	0.148	<0.041	12.8	<0.059	<0.13	2.18	<0.086	0.118	<0.00056	<0.017	<0.047	<0.0097	8.11	144	461	0.013
8/24/2011	BPC1_duplicate	TOLLWAY 1070	<0.043	0.106	<0.041	12.7	<0.059	<0.13	2.21	<0.086	0.119	<0.00056	<0.017	<0.047	<0.0097	8.13	144	448	0.013
		difference	-	0.0424	-	0.140	-	-	0.0240	-	0.000587	-	-	-	-	0.01900	0.888	13.0	0.00012
		% difference	-	28.67	-	1.09	-	-	1.10	-	0.50	-	-	-	-	0.23	0.61	2.82	0.96
9/28/2011	BPC1	TOLLWAY 1162	<0.043	0.202	<0.041	16.0	<0.059	<0.13	2.05	<0.086	0.128	<0.00056	<0.017	<0.047	<0.0097	8.18	141	465	0.016
9/28/2011	BPC1_duplicate	TOLLWAY 1163	<0.043	0.199	<0.041	15.4	<0.059	<0.13	1.97	<0.086	0.124	0.00065	<0.017	<0.047	<0.0097	8.19	141	464	0.016
		difference	-	0.00297	-	0.567	-	-	0.0781	-	0.00425	-	-	-	-	0.01100	0.0260	1.00	0.00037
		% difference	-	1.47	-	3.55	-	-	3.81	-	3.33	-	-	-	-	0.13	0.02	0.22	2.30
11/9/2011	BPC1	TOLLWAY 1213	<0.043	0.161	<0.041	14.0	<0.059	<0.13	1.48	<0.086	0.0965	<0.00056	<0.017	<0.047	<0.0097	7.98	141	458	0.017
11/9/2011	BPC1_duplicate	TOLLWAY 1214	<0.043	0.149	<0.041	13.9	<0.059	<0.13	1.46	<0.086	0.0959	<0.00056	<0.017	<0.047	<0.0097	8.02	141	453	0.018
		difference	-	0.0123	-	0.115	-	-	0.0257	-	0.000540	-	-	-	-	0.04300	0.672	5.00	0.00063
		% difference	-	7.63	-	0.82	-	-	1.73	-	0.56	-	-	-	-	0.54	0.48	1.09	3.61
12/7/2011	BPC2	TOLLWAY 1283	<0.043	0.126	<0.041	21.8	<0.059	<0.13	2.18	<0.086	0.164	<0.00056	<0.017	<0.047	<0.0097	8.06	214	586	0.007
12/7/2011	BPC2_duplicate	TOLLWAY 1284	<0.043	0.130	<0.041	22.0	<0.059	<0.13	2.17	<0.086	0.164	<0.00056	<0.017	<0.047	<0.0097	8.07	215	588	0.006
		difference	-	0.00341	-	0.216	-	-	0.00276	-	0.000241	-	-	-	-	0.00900	0.463	2.00	0.0005
		% difference	-	2.70	-	0.99	-	-	0.13	-	0.15	-	-	-	-	0.11	0.22	0.34	6.80
1/11/2012	BPC6	TOLLWAY 1337	<0.043	0.077	<0.041	22.9	<0.059	<0.13	0.839	<0.086	0.142	<0.00056	<0.017	<0.047	<0.0097	8.34	219	720	<0.003
1/11/2012	BPC6_duplicate	TOLLWAY 1338	<0.043	0.101	<0.041	22.7	<0.059	<0.13	0.839	<0.086	0.143	<0.00056	<0.017	<0.047	<0.0097	8.37	218	712	<0.003
		difference	-	0.024	-	0.194	-	-	0.0000607	-	0.000921	-	-	-	-	0.03100	1.38	8.00	-
		% difference	-	30.94	-	0.85	-	-	0.01	-	0.65	-	-	-	-	0.37	0.63	1.11	-
2/22/2012	BPC5	TOLLWAY 1429	<0.043	0.156	<0.041	37.7	<0.059	<0.13	6.38	<0.086	0.395	<0.00056	<0.017	<0.047	<0.0097	7.39	342	702	0.020
2/22/2012	BPC5_duplicate	TOLLWAY 1430	<0.043	0.166	<0.041	37.4	<0.059	<0.13	6.26	<0.086	0.386	<0.00056	<0.017	<0.047	<0.0097	7.40	343	695	0.020
		difference	-	0.00986	-	0.343	-	-	0.123	-	0.00885	-	-	-	-	0.00800	1.58	7.00	0.00054
		% difference	-	6.33	-	0.91	-	-	1.93	-	2.24	-	-	-	-	0.11	0.46	1.00	2.75
3/27/2012	BPC1	TOLLWAY 1522	<0.043	0.179	<0.041	28.6	<0.059	<0.13	1.86	<0.086	0.258	<0.00056	<0.017	<0.047	<0.0097	8.21	227	1163	0.006
3/27/2012	BPC1_duplicate	TOLLWAY 1523	<0.043	0.166	<0.041	29.1	<0.059	<0.13	1.88	<0.086	0.262	<0.00056	<0.017	<0.047	<0.0097	8.22	227	1109	0.005
		difference	-	0.0129	-	0.527	-	-	0.0207	-	0.00402	-	-	-	-	0.01000	0.563	54.00	0.002
		% difference	-	7.21	-	1.84	-	-	1.12	-	1.56	-	-	-	-	0.12	0.25	4.64	23.95
5/1/2012	BPC6	TOLLWAY 1575	<0.043	0.168	<0.041	21.1	<0.059	<0.13	0.782	<0.086	0.182	<0.00056	<0.017	<0.047	<0.0097	8.15	153	940	0.016
5/1/2012	BPC6_duplicate	TOLLWAY 1576	<0.043	0.214	<0.041	21.0	<0.059	<0.13	0.782	<0.086	0.181	<0.00056	<0.017	<0.047	<0.0097	8.15	153	902	0.014
		difference	-	0.0455	-	0.129	-	-	0.000119	-	0.000655	-	-	-	-	0.00500	0.763	38.0	0.0017
		% difference	-	27.05	-	0.61	-	-	0.02	-	0.36	-	-	-	-	0.06	0.50	4.04	10.80

>20% Relative Percent Difference

APPENDIX C: Results of Geochemical Analysis of ISGS Field Duplicate Samples

Date collected	Sample location	Sample ID	NH_3-N mg/L	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	total NVOC mg/L	dissolved NVOC mg/L	mean relative % difference between duplicate and original sample
		MDL:	0.03	0.08	0.09/0.16*	0.07	0.31	0.31	0.31	
5/18/2011	BPC1	TOLLWAY 882	0.16	0.20	346	0.33	76.4	3.87	4.11	
5/18/2011	BPC1_duplicate	TOLLWAY 883	0.18	0.20	347	0.33	76.5	3.79	4.07	
		difference	0.013	0.000063	0.821	0.0047	0.0925	0.0804	0.0428	
		% difference	8.10	0.03	0.24	1.40	0.12	2.08	1.04	3.40
6/20/2011	BPC1	TOLLWAY 938	<0.03	0.15	133	0.23	23.1	9.90	7.10	
6/20/2011	BPC1_duplicate	TOLLWAY 939	<0.03	0.17	133	0.23	23.0	9.99	7.28	
		difference	-	0.016	0.480	0.0020	0.131	0.0858	0.176	
		% difference	-	10.45	0.36	0.86	0.57	0.87	2.48	3.99
7/27/2011	BPC5	TOLLWAY 1008	<0.03	0.25	134	0.14	91.9	1.15	1.14	
7/27/2011	BPC5_duplicate	TOLLWAY 1009	<0.03	0.23	133	0.14	91.9	1.10	1.17	
		difference	-	0.025	0.502	0.00033	0.0621	0.0503	0.0361	
		% difference	-	9.87	0.38	0.24	0.07	4.36	3.17	1.86
8/24/2011	BPC1	TOLLWAY 1069	<0.03	0.19	149	0.21	36.6	7.16	6.54	
8/24/2011	BPC1_duplicate	TOLLWAY 1070	<0.03	0.19	148	0.21	36.5	7.44	6.61	
		difference	-	0.00052	1.01	0.000023	0.0555	0.290	0.0701	
		% difference	-	0.27	0.68	0.01	0.15	4.05	1.07	2.99
9/28/2011	BPC1	TOLLWAY 1162	<0.03	0.18	156	0.25	41.1	8.00	6.12	
9/28/2011	BPC1_duplicate	TOLLWAY 1163	<0.03	0.18	156	0.25	41.2	7.73	6.08	
		difference	-	0.00077	0.0171	0.00036	0.0816	0.265	0.0408	
		% difference	-	0.42	0.01	0.14	0.20	3.31	0.67	2.91
11/9/2011	BPC1	TOLLWAY 1213	<0.03	0.20	152	0.30	39.7	8.38	6.48	
11/9/2011	BPC1_duplicate	TOLLWAY 1214	<0.03	0.16	151	0.32	39.9	8.24	6.42	
		difference	-	0.048	0.911	0.018	0.161	0.140	0.0643	
		% difference	-	23.54	0.60	5.97	0.41	1.67	0.99	4.38
12/7/2011	BPC2	TOLLWAY 1283	<0.03	0.18	174	0.19	66.2	4.40	4.09	
12/7/2011	BPC2_duplicate	TOLLWAY 1284	<0.03	0.19	175	0.20	66.2	4.30	4.10	
		difference	-	0.0096	0.207	0.013	0.00479	0.100	0.00643	
		% difference	-	5.45	0.12	6.81	0.01	2.27	0.16	1.69
1/11/2012	BPC6	TOLLWAY 1337	<0.03	0.16	252	0.26	70.1	4.90	4.60	
1/11/2012	BPC6_duplicate	TOLLWAY 1338	<0.03	0.18	252	0.26	70.0	5.03	4.51	
		difference	-	0.028	0.429	0.0027	0.162	0.133	0.0859	
		% difference	-	17.84	0.17	1.04	0.23	2.71	1.87	3.64
2/22/2012	BPC5	TOLLWAY 1429	<0.03	0.20	129	0.10	110	0.52	0.48	
2/22/2012	BPC5_duplicate	TOLLWAY 1430	<0.03	0.24	129	0.10	110	0.49	0.48	
		difference	-	0.034	0.531	0.00013	0.156	0.030	0.0015	
		% difference	-	16.96	0.41	0.13	0.14	5.83	0.30	2.61
3/27/2012	BPC1	TOLLWAY 1522	<0.03	0.20	470	0.09	78.1	3.65	3.73	
3/27/2012	BPC1_duplicate	TOLLWAY 1523	<0.03	0.21	468	0.10	78.3	3.66	3.63	
		difference	-	0.011	2.53	0.004	0.151	0.0108	0.107	
		% difference	-	5.86	0.54	3.90	0.19	0.29	2.86	3.71
5/1/2012	BPC6	TOLLWAY 1575	<0.03	0.26	389	0.17	59.5	7.38	6.79	
5/1/2012	BPC6_duplicate	TOLLWAY 1576	<0.03	0.27	392	0.17	59.5	7.33	6.64	
		difference	-	0.0082	3.25	0.0048	0.00770	0.0419	0.153	
		% difference	-	3.12	0.84	2.84	0.01	0.57	2.25	4.90

[highlighted] >20% Relative Percent Difference

mean relative percent difference of all samples= 3.28

mean relative percent difference of all samples, excluding phosphorous= 2.72

APPENDIX D: Results of Geochemical Analysis of ISGS Field Blank Samples

Date collected	Sample location	Sample ID	Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L
		MDL:	0.037	0.11	0.023	0.00085	0.00055	0.029	0.012	0.013	0.0058	0.00079	0.024	0.016	0.11	0.027	0.0015	0.022	0.026
5/19/2011	Blank	TOLLWAY 890	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.448	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
6/21/2011	Blank	TOLLWAY 947	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.238	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
7/28/2011	Blank	TOLLWAY 1016	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.136	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
8/24/2011	Blank	TOLLWAY 1074	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.111	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
9/29/2011	Blank	TOLLWAY 1171	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.048	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
11/10/2011	Blank	TOLLWAY 1222	<0.037	<0.11	0.027	<0.00085	<0.00055	0.078	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
12/8/2011	Blank	TOLLWAY 1287	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.065	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
1/11/2012	Blank	TOLLWAY 1345	<0.037	<0.11	0.026	<0.00085	<0.00055	0.076	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
2/22/2012	Blank	TOLLWAY 1433	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.137	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	0.037	<0.0015	<0.022	0.081
3/28/2012	Blank	TOLLWAY 1531	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.107	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	<0.027	<0.0015	<0.022	<0.026
5/2/2012	Blank	TOLLWAY 1584	<0.037	<0.11	<0.023	<0.00085	<0.00055	0.168	<0.012	<0.013	<0.0058	<0.00079	<0.024	<0.016	<0.11	0.036	<0.0015	<0.022	<0.026
	11 total samples	detects	0	0	2	0	0	11	0	0	0	0	0	0	0	2	0	0	1
		min	-	-	0.026	-	-	0.048	-	-	-	-	-	-	-	0.036	-	-	0.081
		max	-	-	0.027	-	-	0.448	-	-	-	-	-	-	-	0.037	-	-	0.081
		mean	-	-	0.027	-	-	0.146	-	-	-	-	-	-	-	0.037	-	-	0.081

Date collected	Sample location	Sample ID	Ni mg/L	P mg/L	Pb mg/L	S mg/L	Sb mg/L	Se mg/L	Si mg/L	Sn mg/L	Sr mg/L	Ti mg/L	Tl mg/L	V mg/L	Zn mg/L	pH	alkalinity mg/L as $CaCO_3$	TDS, 180 C mg/L	oPO_4-P mg/L
		MDL:	0.043	0.073	0.041	0.22	0.059	0.13	0.066	0.086	0.00037	0.00056	0.017	0.047	0.0097		4	12	0.003
5/19/2011	Blank	TOLLWAY 890	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	0.00176	<0.00056	<0.017	<0.047	<0.0097	5.52	<4	<12	<0.003
6/21/2011	Blank	TOLLWAY 947	<0.043	0.089	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	0.00079	<0.00056	<0.017	<0.047	<0.0097	5.29	<4	<12	<0.003
7/28/2011	Blank	TOLLWAY 1016	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.36	<4	<12	<0.003
8/24/2011	Blank	TOLLWAY 1074	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.26	<4	<12	<0.003
9/29/2011	Blank	TOLLWAY 1171	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.59	<4	<12	<0.003
11/10/2011	Blank	TOLLWAY 1222	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.77	<4	<12	<0.003
12/8/2011	Blank	TOLLWAY 1287	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.63	<4	<12	<0.003
1/11/2012	Blank	TOLLWAY 1345	<0.043	0.086	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.41	<4	<12	<0.003
2/22/2012	Blank	TOLLWAY 1433	<0.043	0.086	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	0.00048	<0.00056	<0.017	<0.047	<0.0097	5.74	<4	<12	0.005
3/28/2012	Blank	TOLLWAY 1531	<0.043	0.078	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	<0.00037	<0.00056	<0.017	<0.047	<0.0097	5.80	<4	<12	<0.003
5/2/2012	Blank	TOLLWAY 1584	<0.043	<0.073	<0.041	<0.22	<0.059	<0.13	<0.066	<0.086	0.00044	<0.00056	<0.017	<0.047	<0.0097	5.94	<4	<12	<0.003
	11 total samples	detects	0	4	0	0	0	0	0	0	4	0	0	0	0	11	0	0	1
		min	-	0.078	-	-	-	-	-	-	0.00044	-	-	-	-	5.26	-	-	0.005
		max	-	0.089	-	-	-	-	-	-	0.00176	-	-	-	-	5.94	-	-	0.005
		mean	-	0.085	-	-	-	-	-	-	0.00087	-	-	-	-	5.57	-	-	0.005

Date collected	Sample location	Sample ID	NH_3-N mg/L	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	total NVOC mg/L	dissolved NVOC mg/L	# detects* per blank sample
		MDL:	0.03	0.08	0.09/0.16	0.07	0.31	0.31	0.31	
5/19/2011	Blank	TOLLWAY 890	0.35	<0.08	<0.09	<0.07	<0.31	1.07	1.03	2
6/21/2011	Blank	TOLLWAY 947	<0.03	<0.08	<0.09	<0.07	<0.31	1.89	1.86	3
7/28/2011	Blank	TOLLWAY 1016	<0.03	<0.08	<0.09	<0.07	<0.31	0.86	0.86	1
8/24/2011	Blank	TOLLWAY 1074	<0.03	<0.08	<0.09	<0.07	<0.31	0.74	0.91	1
9/29/2011	Blank	TOLLWAY 1171	<0.03	<0.08	<0.09	<0.07	<0.31	0.84	0.72	1
11/10/2011	Blank	TOLLWAY 1222	<0.03	<0.08	<0.09	<0.07	<0.31	0.43	0.53	2
12/8/2011	Blank	TOLLWAY 1287	<0.03	<0.08	<0.09	<0.07	<0.31	<0.31	0.53	1
1/11/2012	Blank	TOLLWAY 1345	<0.03	<0.08	<0.09	<0.07	<0.31	0.40	0.42	3
2/22/2012	Blank	TOLLWAY 1433	<0.03	<0.08	<0.16	<0.07	<0.31	<0.31	<0.31	3
3/28/2012	Blank	TOLLWAY 1531	<0.03	<0.07	<0.16	<0.04	<0.21	<0.31	<0.31	2
5/2/2012	Blank	TOLLWAY 1584	<0.03	<0.07	<0.16	<0.04	<0.21	0.44	0.50	2
	11 total samples	detects	1	0	0	0	0	8	9	
		min	0.35	-	-	-	-	0.40	0.42	
		max	0.35	-	-	-	-	1.89	1.86	
		mean	0.35	-	-	-	-	0.83	0.82	

1.909	**mean # of detects* per blank sample**
0.808	**mean # of detects* per analyte**
0.038	**mean of minima detected***
0.141	**mean of maxima detected***
0.065	**mean of analyte means detected***

*not including pH

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al	As	B	Ba	Be	Ca	Cd	Co	Cr
							mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC1**	7.83	1530		13		0.08	<0.1	0.06	0.06	<1	108	<0.01	<0.01	<0.01
Apr-94	**BPC1**	7.76	2043	8.3	2		<.30	<.1	0.08	0.06	<.001	107	<.01	<.01	<.01
May-94	**BPC1**	7.94	1659	14.9	1		0.05	<0.1	0.07	0.06	<1	111	<.01	<0.01	<.01
Jun-94	**BPC1**	7.79	556	19.9	170		0.21	<0.1	0.06	0.04	<1	31.7	<.01	<0.01	<0.01
Jul-94	**BPC1**	8.18	1397	15.7	6		0.05	<.1	0.09	0.06	<.001	107	<.02	<.02	<.01
Aug-94	**BPC1**	8.12	1345	15.8	1		0.03	<.1	0.11	0.06	<.001	111	<.01	<.01	<.01
Sep-94	**BPC1**	8.10	1450	13.8	2		<.02	<.1	0.09	0.05	<.001	103	<.01	<.01	<.01
Oct-94	**BPC1**	7.93	946	7.4	34		0.1	<.1	<.02	0.04	<.001	51.2	<.01	<.01	<.01
Nov-94	**BPC1**	8.20	1916	3.5	10		0.05	<.1	0.07	0.05	<.001	91.4	<.01	<.01	<.01
Dec-94	**BPC1**														
Jan-95	**BPC1**	8.16	2776	2.6	1		<.03	<.1	0.1	0.07	<.001	107	<.01	<.01	<.01
Feb-95	**BPC1**	8.04	2212	5.5	1		<.02	<.1	0.04	0.06	<.002	107	<.01	<.01	<.01
Mar-95	**BPC1**	8.07	2408	6.1	38		<.02	<.1	<.02	0.06	<.001	88.2	<.01	<.01	<.01
Apr-95	**BPC1**	8.65	1618	12.7	1		<.02	<.1	0.06	0.05	0.001	89.9	<.01	<.01	<.01
May-95	**BPC1**	8.18	1283	17.0	3		<.02	<.1	0.07	0.05	<.001	82.3	<.01	<.01	<.01
Jun-95	**BPC1**														
Jul-95	**BPC1**														
Aug-95	**BPC1**														
Sep-95	**BPC1**														
Oct-95	**BPC1**														
Nov-95	**BPC1**	7.89	2398	4.4	1		0.04	<.1	0.05	0.06	<1	108	<.01	<.01	<.01
Dec-95	**BPC1**	8.10	2604	4.4	0		<.01	<.1	0.08	0.06	<.001	121	<.01	<.01	<.01
Jan-96	**BPC1**	8.03	3665	0.6	1		0.03	<.1	0.06	0.07	<.002	126	<.01	<.01	<.01
Feb-96	**BPC1**	8.22	3435	3.4	0		<.01	<.1	0.06	0.06	<.002	122	<.01	<.01	<.01
Mar-96	**BPC1**	8.12	3629	7.3	0		0.02	<.1	0.06	0.06	<.001	119	<.01	<.01	<.01
Apr-96	**BPC1**	8.14	2381	12.7	3		0.05	<.1	0.06	0.16	<.001	87.2	<.01	<.01	<.01
May-96	**BPC1**	7.94	1160	18.2	2		0.05	<.1	0.11	0.27	<.001	84.6	<.01	<.01	<.01
Jun-96	**BPC1**	8.27	1510	16.9	2		0.04	<.1	0.11	0.06	<.001	104	<.01	<.01	<.01
Jul-96	**BPC1**	7.97	1230	18.5	50		0.02	<.1	0.15	0.06	<.001	82.2	<.01	<.01	<.01
Aug-96	**BPC1**	8.26	1450	17.9	1		0.03	<.1	0.16	0.07	<.001	115	<.01	<.01	<.01
Sep-96	**BPC1**	7.62	663	15.7	376		<.03	<.1	0.07	0.04	<.001	66.3	<.01	<.01	<.01
Oct-96	**BPC1**	7.64	627	12.1	55		<.03	<.1	0.08	0.05	<.001	69.3	<.01	<.01	<.01
Nov-96	**BPC1**	7.80	730	6.5	5		<.02	<.1	0.07	0.05	<.001	98.8	<.01	<.01	<.01
Dec-96	**BPC1**	7.56	544	4.4	1823		0.06	<.1	0.05	0.05	<.001	60.7	0.01	<.01	<.01
Jan-97	**BPC1**	8.01	1676				0.05	<.1	0.05	0.08	<.001	149	<.01	<.01	<.01
Feb-97	**BPC1**	8.10	566	1.2	112		0.14	<.2	0.03	0.05	<.001	74.9	<.01	<.01	<.01
Mar-97	**BPC1**	8.49	855	8.6	4		<.02	<.1	0.06	0.05	<.001	95.1	<.01	<.01	<.01
Apr-97	**BPC1**	8.22	976	11.7	1		<.03	<.1	0.07	0.06	<.001	107	<.01	<.01	<.01
May-97	**BPC1**	7.95	835	10.4	3		<.04	<.2	0.11	0.06	<.002	105	<.01	<.01	<.01
Jun-97	**BPC1**	7.88	863	13.5	5		<.02	<.1	0.07	0.06	<.002	98.3	<.01	<.01	<.01
Jul-97	**BPC1**	7.72	1110	15.5	2		0.04	<.1	0.09	0.06	<.001	116	<.01	<.01	<.01
Aug-97	**BPC1**	8.01	663	17.3	74		<.02	<.1	0.09	0.05	<.001	68.9	<.01	<.01	<.01
Sep-97	**BPC1**	7.81	779	12.0	5		0.03	<.2	0.09	0.06	<.001	106	<.01	<.01	<.01
Oct-97	**BPC1**	7.98	720	10.7	6		0.03	<.2	0.07	0.06	<DL	95.2	<.01	<.01	<.01
Nov-97	**BPC1**	8.05	1168	5.7	1		<.02	<.3	0.07	0.06	<.002	110	<.01	<.01	<.01
Dec-97	**BPC1**	7.86	1254	5.7	5		0.06	<.3	0.08	0.05	<.002	101	<.01	<.01	0.02
Jan-98	**BPC1**	8.31	1690	2.1	31		<.02	<.1	0.05	0.05	<.001	69.2	<.01	<.01	<.01
Feb-98	**BPC1**	8.49	1254	8.1	12		0.03	<.2	0.06	0.05	<.001	90.9	<.01	<.01	<.01
Mar-98	**BPC1**	8.48	1241	13.9	16		0.03	<.1	0.06	0.05	<.001	81.8	<.01	<.01	<.01
Apr-98	**BPC1**	8.06	757	13.5	26		<.02	<.1	0.06	0.04	<.001	64.2	<.01	<.01	<.01
May-98	**BPC1**	8.04	972	14.9	4		<.02	<.1	0.07	0.05	<.001	88.8	<.01	<.01	<.01
Jun-98	**BPC1**	7.59	868	18.4	10		<.02	<.1	0.08	0.05	<.001	82.6	<.01	<.01	<.01
Jul-98	**BPC1**	7.86	774	20.7	12		<.02	<.1	0.08	0.06	<.001	98.7	<.02	<.01	<.01
Aug-98	**BPC1**	7.85	581	21.4	23		<.02	<.1	0.07	<DL	<.001	54.7	<.02	<.01	<.01
Sep-98	**BPC1**	8.19	556	20.8	51		0.08	<.1	0.06	<DL	<.003	47	<.01	<.01	<.01
Oct-98	**BPC1**	8.07	763	15.0	63		0.05	<.1	0.1	0.05	<.001	67	<.01	<.01	<.01
Nov-98	**BPC1**	7.92	903	8.1	11		0.05	<.1	0.08	0.06	<.001	88.7	<.01	<.01	<.01
Dec-98	**BPC1**														
Jan-99	**BPC1**	7.08	2022	4.1	7		<.01	<.1	0.08	0.08	<.001	105	<.01	<.01	<.01
Feb-99	**BPC1**	6.83	1231	4.2	5		0.02	<.1	0.05	0.06	<DL	97	<.01	<.01	<.01
Mar-99	**BPC1**	7.02	1434	7.1	6		<.01	<.1	0.07	0.07	<.002	102	<.01	<.01	<.01
Apr-99	**BPC1**														
May-99	**BPC1**														
Jun-99	**BPC1**														
Jul-99	**BPC1**	7.47	959	14.0	20		<.02	<.1	0.09	0.05	<.001	105	<.01	<.01	<.01
Aug-99	**BPC1**	7.39	954	18.8	11		<.02	<.1	0.08	0.06	<.003	105	<.01	<.01	<.01
Sep-99	**BPC1**	7.71	493	15.6	47		0.07	<.1	0.07	<DL	<.001	45.5	<.01	<.01	<.01
Oct-99	**BPC1**	7.80		10.0	0		0.05	<.1	0.1	0.06	<.002	106	<.01	<.01	<.01
Nov-99	**BPC1**														
Dec-99	**BPC1**	8.05	961	7.5	1		<.02	<.2	0.07	0.05	<.001	87.3	<.01	<.01	<.01
Jan-00	**BPC1**	8.00	1463	3.6	34		<.02	<.2	0.06	0.06	<.001	97.3	<.01	<.01	<.01
Feb-00	**BPC1**	8.02	2790	4.3	72		<DL	<.2	0.05	0.082	<.001	111	<.01	<.01	<.01
Mar-00	**BPC1**	8.11	2106	7.4	5		<.01	<.1	0.07	0.078	<.001	119	<.02	<.01	<.01
Apr-00	**BPC1**	8.23	1170	12.3	34		<.02	<.1	0.07	0.035	<.001	57.7	<.01	<.01	<.01
May-00	**BPC1**	8.08	973	16.8	73		<.02	<.1	0.06	0.064	<.001	72.9	<.01	<.01	<.01
Jun-00	**BPC1**	8.19	799	22.6	121		<.01	<.1	0.08	0.043	<.001	60.4	<.01	<.01	<.01
Jul-00	**BPC1**	8.05	1029	17.6	12		<DL	<.1	0.1	0.066	<.001	92.2	<.01	<.01	<.01
Aug-00	**BPC1**	8.06	972	18.9	10		<.01	<.2	0.093	0.058	<.001	79.1	<.01	<.01	<.01
Sep-00	**BPC1**	7.98	866	14.2	17		<.1	<.2	0.08	0.021	<.001	54.8	<.01	<.01	<.01
Oct-00	**BPC1**	7.69	1073	15.4	5		<.1	<.2	0.09	0.055	<.001	88.3	<.01	<.01	<.01
Nov-00	**BPC1**	7.62	1061	2.8	10		<.02	<.05	0.075	0.05	<.001	94.4	<.01	<.01	<.01
Dec-00	**BPC1**														
Jan-01	**BPC1**	7.84	1892	2.4	2		<.3	<.1	0.09	<.001	<.001	123	<.01	<.01	<.01
Feb-01	**BPC1**	7.59	1522	2.4	76		<.3	<.1	0.05	0.049	<.001	75.4	<.01	<.01	<.01
Mar-01	**BPC1**	7.96	1593	7.1	4		<.3	<.1	0.07	0.059	<.001	103	<.01	<.01	<.01
Apr-01	**BPC1**	8.11	1382	16.2	27		<.02	<.1	0.04	0.03	<.001	54.1	<.01	<.01	<.01
May-01	**BPC1**	7.74	1405	11.9	19		<DL	<.1	0.1	0.057	<.001	89.3	<.01	<.01	<.01
Jun-01	**BPC1**	7.78	1276	16.3	20		<DL	<.1	0.06	0.057	<.001	88.6	<.01	<.01	<.01
Jul-01	**BPC1**	7.86	993	24.0	28		<DL	<.1	0.05	0.043	<.001	53.7	<.01	<.01	<.01
Aug-01	**BPC1**	7.60	990	18.5	7		<DL	<.2	0.09	0.05	<.001	73.1	<.01	<.01	<.01
Sep-01	**BPC1**	7.56	928	12.8	10		<.01	<.2	0.06	0.048	<.001	77.9	<.01	<.01	<.01
Oct-01	**BPC1**	7.67	893	9.5	16		<.02	<.2	0.08	0.036	<.003	58.7	<.01	<.01	<.04
Nov-01	**BPC1**														
Dec-01	**BPC1**	7.75	990	3.5	4		<.02	<.2	0.09	0.048	<.003	82.1	<.01	<.01	<.04
Jan-02	**BPC1**														
Feb-02	**BPC1**	7.25	1591	4.4	3		<.02	<.1	0.08	0.068	<.001	106	<.01	<.01	<.01
Mar-02	**BPC1**	7.41	1699	6.0	24		<.02	<.1	0.1	0.06	0.006	99.8	<.01	0.01	<.01
Apr-02	**BPC1**	8.01	1482	11.5	18		<.1	<.1	0.06	0.027	<.001	44.7	<.01	<.01	<.01
May-02	**BPC1**	7.21	1006	14.6	27		<.1	<.1	0.07	0.02	<.001	30.8	<.01	<.01	<.01
Jun-02	**BPC1**	7.45	811	17.8	566		<.02	<.1	0.03	0.025	<.002	33.6	<.01	<.01	<.01
Jul-02	**BPC1**	7.99	1106	20.4	32		<.02	<.1	0.04	0.021	<.002	40.4	<.01	<.01	<.01
Aug-02	**BPC1**	7.77	756	20.0	35		<.02	<.1	0.03	0.044	<.002	66	<.01	<.01	<.01
Sep-02	**BPC1**	7.70	967	16.8	3		<.01	<.1	0.06	0.016	<.001	31.4	<.01	<.01	<.01
	samples analyzed						89	89	89	89	89	89	89	89	89
	detects						30	0	87	85	2	89	1	1	1
	% detects						34	0	98	96	2	100	1	1	1
	min	6.83	493	0.6	0		0.02	-	0.03	0.016	0.001	30.8	0.01	0.01	0.02
	max	8.65	3665	24.0	1823		0.21	-	0.16	0.27	0.006	149	0.01	0.01	0.02
	mean	7.90	1325	12	51		0.05	-	0.07	0.06	0.004	86.9	na	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	Ni mg/L	P mg/L	Pb mg/L	S mg/L	Sb mg/L	Se mg/L
		0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC1**	<0.01	0.07	3	0.01	55.5	0.02	<0.01	144	<.03	<DL	<.08	na	<.1	0.1
Apr-94	**BPC1**	<.01	<.01	4	0.01	60.3	0.02	<.01	103	<.03	<.01	<.08	na	<.1	<.1
May-94	**BPC1**	<0.01	<.01	4	0.01	61.7	0.03	<.01	101	<.03	0.01	<.08	na	<.1	<.1
Jun-94	**BPC1**	<DL	0.2	<1	<0.01	15.4	0.19	<.01	62.7	<.03	0.29	<.08	na	<.1	<.1
Jul-94	**BPC1**	<.01	0.05	3	<.01	57.3	0.03	<.02	75.4	<.04	0.1	<.04	na	<.2	<.2
Aug-94	**BPC1**	<.01	0.04	3	0.01	58.4	0.02	<.02	58.7	<.03	0.05	<.08	na	<.1	<.1
Sep-94	**BPC1**	<.01	<DL	3	0.01	53.9	0.02	<.02	52.9	<.03	0.04	<.05	na	<.1	<.2
Oct-94	**BPC1**	<.01	0.11	4	<.01	22.6	0.06	<.02	57.7	<.03	0.15	<.05	na	<.2	<.2
Nov-94	**BPC1**	<.01	<.01	3	0.01	43.5	0.01	<.02	66.6	<.03	0.03	<.06	na	<.1	<.2
Dec-94	**BPC1**														
Jan-95	**BPC1**	<.01	<.01	3	<.01	51.6	0.02	<.02	137	<.03	0.06	<.05	na	<.3	<.1
Feb-95	**BPC1**	<.01	<.01	2	<.01	50.2	0.01	<.02	102	<.02	0.01	<.04	na	<.1	<.1
Mar-95	**BPC1**	<.01	<.01	<1	<.01	41.7	0.04	<.02	157	<.03	0.13	<.05	na	<.2	<.1
Apr-95	**BPC1**	<.01	<.01	<1	<.01	47.8	0.01	<.02	90.3	<.03	0.03	<.05	na	<.2	<.1
May-95	**BPC1**	<.01	<.01	2	<.01	40.9	<.01	<.02	63.6	<.03	0.02	<.08	na	<.1	<.1
Jun-95	**BPC1**														
Jul-95	**BPC1**														
Aug-95	**BPC1**														
Sep-95	**BPC1**														
Oct-95	**BPC1**														
Nov-95	**BPC1**	<DL	<.01	2	0.01	52.8	0.01	<.02	122	<.03	0.03	<.05	na	<.2	<.2
Dec-95	**BPC1**	<.01	<.01	3	0.01	60.0	0.01	<.02	114	<.03	0.01	<.05	na	<.2	<.1
Jan-96	**BPC1**	<DL	<DL	4	<.01	60.7	0.01	<.02	139	<.03	0.01	<.05	na	<.2	<.1
Feb-96	**BPC1**	<.01	0.04	4	<.01	59.5	0.01	<.02	142	<.03	0.02	<.08	na	<.1	<.1
Mar-96	**BPC1**	<.01	<.01	3	0.01	58.9	<.01	<.02	66.3	<.03	<DL	<.04	na	<.1	<.1
Apr-96	**BPC1**	<DL	<.01	2	<.01	41.6	0.02	<.02	206	<.03	0.06	<.05	na	<.1	<.2
May-96	**BPC1**	<DL	<.01	3	<.01	43.1	<.01	<.02	136	<.03	0.01	<.05	na	<.2	<.1
Jun-96	**BPC1**	0.15	<.01	<1	<.01	49.8	0.01	<.02	88.8	<.03	0.04	<.05	na	<.2	<.2
Jul-96	**BPC1**	0.02	<.01	3	<.01	36.8	0.01	<.02	67.1	<.03	0.01	<.04	na	<.2	<.2
Aug-96	**BPC1**	<DL	<.01	3	<.03	55.0	0.01	<.02	69.1	<.03	0.03	<.05	na	<.2	<.2
Sep-96	**BPC1**	<.01	<.01	6	<.01	31.4	0.07	<.02	55.4	<.03	0.06	<.05	na	<.2	<.2
Oct-96	**BPC1**	0.03	<.01	3	<.01	32.5	<.01	<.02	64.8	<.03	0.07	<.05	na	<.2	<.2
Nov-96	**BPC1**	0.02	<.01	3	<.01	48.1	0.01	<.02	78.8	<.03	0.01	<.04	na	<.2	<.2
Dec-96	**BPC1**	<.01	<.03	3	<.01	25.9	<.01	<.02	99.8	<.03	0.12	<.05	na	<.2	<.2
Jan-97	**BPC1**	0.06	<.1	3	<.01	48.0	0.02	<.02	225	<.03	0.05	<.05	na	<.2	<.2
Feb-97	**BPC1**	0.06	<.03	2	<.01	34.3	<.01	<.02	124	<.03	0.07	<.05	na	<.2	<.2
Mar-97	**BPC1**	<.01	<.01	2	<.01	45.5	<.01	<.02	105	<.03	0.03	<.05	na	<.2	<.2
Apr-97	**BPC1**	<.01	<DL	4	0.01	54.4	0.02	<.01	116	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC1**	<.02	<.01	3	0.01	52.7	0.03	0.05	106	<.03	0.02	<.05	na	<.2	<.2
Jun-97	**BPC1**	<.02	<.01	2	<.01	49.3	0.02	<.02	97.3	<.03	0.09	<.05	na	<.2	<.1
Jul-97	**BPC1**	<.01	<.01	3	0.01	52.8	0.01	<.01	77.3	<.03	<DL	<.05	na	<.2	<.2
Aug-97	**BPC1**	<.01	<DL	<1	<.01	30.3	<.01	<.02	59.5	<.03	<DL	<.05	na	<.2	<.2
Sep-97	**BPC1**	<.01	<.01	3	0.01	49.0	<.01	<.02	65	<.03	<DL	<.05	na	<.2	<.1
Oct-97	**BPC1**	<DL	<.01	3	0.01	43.3	0.01	<.02	55.8	<.03	<DL	<.05	na	<.2	<.1
Nov-97	**BPC1**	<.02	<.01	2	0.01	52.3	0.01	<.02	71.3	<.03	0.03	<.05	na	<.2	<.2
Dec-97	**BPC1**	<.02	0.04	4	0.01	47.1	0.01	1.94	117	<.03	<DL	<.05	na	<.2	<.2
Jan-98	**BPC1**	<.01	<.01	3	<.01	30.1	0.02	<.02	180	<.03	0.04	<.05	na	<.1	<.2
Feb-98	**BPC1**	<.01	<.02	3	0.01	43.1	0.01	<.02	142	<.03	<DL	<.05	na	<.2	<.1
Mar-98	**BPC1**	<.01	<.01	3	0.01	38.9	<.01	<.01	119	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC1**	<.01	<.01	3	<.01	30.9	<.01	<.02	86.9	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC1**	<.01	<.01	3	0.01	42.5	0.01	<.02	77.9	<.03	0.13	<.05	na	<.1	<.2
Jun-98	**BPC1**	<.01	<.01	3	<.01	39.2	0.01	<.02	71.2	<.03	0.03	<.05	na	<.1	<.2
Jul-98	**BPC1**	<.03	<.01	2	<.02	33.7	<.01	<.02	57.3	<.03	0.06	<.05	na	<.3	<.2
Aug-98	**BPC1**	<.03	0.04	<2	<.02	24.6	<.01	<.02	35.1	<.03	0.03	<.05	na	<.3	<.2
Sep-98	**BPC1**	<.01	<DL	4	<.01	20.4	<.01	0.13	40.2	<.03	0.04	<.07	na	<.2	<.1
Oct-98	**BPC1**	<.01	0.05	3	0.01	30.0	<.01	<.02	56.5	<.03	0.02	<.05	na	<.2	<.2
Nov-98	**BPC1**	<.01	<DL	4	0.01	41.6	0.01	<.02	69.7	<.03	0.03	<.05	na	<.2	<.2
Dec-98	**BPC1**														
Jan-99	**BPC1**	<.01	<.01	2	<.01	49.0	0.02	0.1	279	<.03	<DL	<.05	na	<.2	<.1
Feb-99	**BPC1**	<.01	<.01	4	<.01	46.3	0.01	<.02	123	<.03	<DL	<.03	na	0.4	<.2
Mar-99	**BPC1**	<.01	<.01	4	<.01	50.4	<.01	<.02	175	<.03	<DL	<.03	na	<.2	<.2
Apr-99	**BPC1**														
May-99	**BPC1**														
Jun-99	**BPC1**														
Jul-99	**BPC1**	<.01	<.01	<1	0.01	50.2	<.01	<.02	58.8	<.03	0.06	<.05	na	<.1	<.1
Aug-99	**BPC1**	<.01	<.01	<1	<.01	52.6	0.01	<.02	54.2	<.02	<DL	<.05	na	<.2	<.2
Sep-99	**BPC1**	<.01	0.04	3	<.05	22.1	<.01	<.02	34.3	<.03	0.12	<.05	na	<.3	<.2
Oct-99	**BPC1**	<.01	<DL	4	0.01	50.6	0.03	<.02	50.9	<.03	0.07	<.05	na	<.3	<.2
Nov-99	**BPC1**														
Dec-99	**BPC1**	<.01	<.01	4	0.01	40.4	<.01	<.02	66.3	<.03	0.13	<.05	na	<.1	<.2
Jan-00	**BPC1**	<.01	<.01	3	<.01	44.7	<.01	<.02	140	<.1	0.05	<.05	na	<.2	<.2
Feb-00	**BPC1**	<.01	<.01	6	0.01	45.3	0.003	<.02	405	<.01	0.06	<.02	na	<.05	<.05
Mar-00	**BPC1**	0.01	<.01	3	0.01	58.4	0.003	<.01	269	<.01	<DL	<.03	na	<.1	<.1
Apr-00	**BPC1**	<.01	0.01	4	<.01	38.7	0.004	<.01	129	<.01	<DL	<.02	na	<.1	<.1
May-00	**BPC1**	<.01	0.02	3	<.01	33.2	0.004	<.01	98.1	<.01	<DL	<.02	na	<.1	<.1
Jun-00	**BPC1**	0.01	0.03	3	<DL	27.9	0.005	<.01	71.8	0.07	<DL	<.03	na	<.1	<.1
Jul-00	**BPC1**	<.01	<.01	4	0.01	43.5	0.024	<.02	71.7	<.01	<DL	<.02	na	<.1	<.1
Aug-00	**BPC1**	<.001	<.01	3	0.01	40.3	0.018	<.03	78	<.01	<DL	<.03	na	<.1	<.1
Sep-00	**BPC1**	<.01	<.01	<1	<.01	37.7	0.007	<.02	57.5	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC1**	<.01	0.03	4	<.01	44.4	0.009	<.02	78	<.01	<DL	<.03	na	<.2	<.2
Nov-00	**BPC1**	<.005	<.01	4	0.01	45.9	0.004	<.01	80.2	<.01	<DL	<.02	na	<.1	<.1
Dec-00	**BPC1**														
Jan-01	**BPC1**	<.003	<.01	5	0.01	56.1	0.016	<.02	214	<.01	<DL	<.05	na	<.1	<.1
Feb-01	**BPC1**	<.003	0.03	5	<.01	33.3	0.002	<.02	219	<.01	<DL	<.05	na	<.1	<.1
Mar-01	**BPC1**	<.003	<.01	5	<.01	52.8	<.001	<.02	196	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC1**	<.01	0.11	5	<.01	33.3	0.009	<.02	147	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC1**	<.01	<.01	4	0.01	46.0	<.003	<.02	164	<.01	<DL	<.05	na	<.1	<.1
Jun-01	**BPC1**	<.01	<.01	3	0.01	45.0	<.002	<.02	132	<.01	<DL	<.05	na	<.1	<.1
Jul-01	**BPC1**	<.01	0.04	4	<.01	26.8	<.002	<.02	121	<.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC1**	<.01	0.03	4	0.01	35.5	0.004	<.01	86.5	<.01	<DL	<.05	na	<.1	<.1
Sep-01	**BPC1**	<.01	<.01	4	<.01	36.3	<.004	<.01	83.3	<.01	<DL	<.05	na	<.1	<.1
Oct-01	**BPC1**	<.004	0.01	4	<.01	30.6	0.005	<.01	70.5	<.01	<DL	<.02	na	<.1	<.2
Nov-01	**BPC1**														
Dec-01	**BPC1**	<.003	<.01	3	0.02	37.4	<.001	<.01	92.4	<.01	<DL	<.02	na	<.1	<.2
Jan-02	**BPC1**														
Feb-02	**BPC1**	<DL	<.01	<1	0.01	49.7	0.014	<.05	177	<.01	0.01	<.03	na	<.1	<.1
Mar-02	**BPC1**	0.009	<.01	<1	<.01	39.3	0.008	<.05	221	<.01	0.02	<.03	na	<.1	<.1
Apr-02	**BPC1**	0.01	<.01	4	0.01	27.9	0.007	<.01	155	0.01	0.06	<.02	na	<.1	<.1
May-02	**BPC1**	<.01	<.01	2	<.01	23.8	0.004	<.01	122	<.01	0.02	<.02	na	<.1	<.1
Jun-02	**BPC1**	<.01	<.01	3	<.01	22.8	0.011	<.01	77.5	<.01	0.03	<.05	na	<.1	<.1
Jul-02	**BPC1**	0.01	<.01	<1	0.01	25.9	0.007	<.01	58.8	<.01	0.04	<.05	na	<.1	<.1
Aug-02	**BPC1**	<.01	0.01	4	<.01	28.1	0.011	<.01	54	<.01	0.02	<.05	na	<.1	<.1
Sep-02	**BPC1**	<.01	0.01	2	<.01	18.3	0.006	<.01	28.3	<.01	<DL	<.05	na	<.1	<.1
	samples analyzed	89	89	89	89	89	89	89	89	89	89	89	na	89	89
	detects	9	21	77	37	89	63	4	89	2	54	0	na	1	1
	% detects	10	24	87	42	100	71	4	100	2	61	0	na	1	1
	min	0.009	0.01	2	0.01	15.4	0.002	0.05	28.3	0.01	0.01	-	na	0.4	0.1
	max	0.15	0.2	6	0.02	61.7	0.19	1.94	405	0.07	0.29	-	na	0.4	0.1
	mean	0.04	0.05	3	0.01	42.0	0.02	0.6	108	0.04	0.05	-	na	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC1**	3.75	na	0.18	<.01	<.1	<.01	<.01	na	279	972	na	na	0.02
Apr-94	**BPC1**	3.51	na	0.23	<.01	0.4	<.01	<.01	na	288	932	na	na	0.04
May-94	**BPC1**	4.69	na	0.25	<.01	<.3	<.01	<.01	na	285	872	na	na	0.13
Jun-94	**BPC1**	2.23	na	0.08	<.01	<.3	<.01	<.01	na	80	348	na	na	0.21
Jul-94	**BPC1**	5.76	na	0.26	<.01	<.2	<.01	<.02	na	290	676	na	na	0.04
Aug-94	**BPC1**	6.37	na	0.26	<.01	<.3	<.01	<.01	na	315	828	na	na	0.07
Sep-94	**BPC1**	6.16	na	0.25	<.01	<.3	<.01	<.01	na	307	796	na	na	0.05
Oct-94	**BPC1**	3.07	na	0.11	0.01	<.4	<.01	0.01	na	134	476	na	na	0.07
Nov-94	**BPC1**	4.2	na	0.16	<.01	<.3	<.01	0.01	na	256	804	na	na	<DL
Dec-94	**BPC1**													
Jan-95	**BPC1**	3.86	na	0.19	<.01	<.3	<.01	0.02	na	270	1024	na	na	0.15
Feb-95	**BPC1**	4.24	na	0.21	<.01	<.2	<.01	0.21	na	272	700	na	na	0.03
Mar-95	**BPC1**	2.16	na	0.14	<.01	<.4	<.01	0.04	na	215	804	na	na	0.07
Apr-95	**BPC1**	2.3	na	0.17	<.01	<.4	<.01	0.01	na	241	700	na	na	0.02
May-95	**BPC1**	3.97	na	0.15	<.01	<.3	<.01	0.48	na	287	620	na	na	0.09
Jun-95	**BPC1**													
Jul-95	**BPC1**													
Aug-95	**BPC1**													
Sep-95	**BPC1**													
Oct-95	**BPC1**													
Nov-95	**BPC1**	4.67	na	0.24	<.01	<.4	<.01	0.15	na	268	896	na	na	0.14
Dec-95	**BPC1**	4.39	na	0.27	<.01	<.3	<.01	<.01	na	282	1000	na	na	0.02
Jan-96	**BPC1**	4.06	na	0.26	<.01	<.6	<.01	0.02	na	260	1128	na	na	0.28
Feb-96	**BPC1**	3.66	na	0.25	<.01	<.3	<.01	<.01	na	272	1036	na	na	0.09
Mar-96	**BPC1**	6.03	na	0.37	<.01	<.3	<.01	0.01	na	337	888	na	na	0.34
Apr-96	**BPC1**	2.35	na	0.18	<.01	<.3	<.01	0.07	na	199	1180	na	na	0.06
May-96	**BPC1**	2.92	na	0.17	<.01	<1	<.01	0.07	na	235	876	na	na	0.01
Jun-96	**BPC1**	4.87	na	0.19	<.01	<.6	<.01	0.1	na	291	732	na	na	<DL
Jul-96	**BPC1**	4.95	na	0.13	<.01	<.2	<.01	0.11	na	234	672	na	na	0.1
Aug-96	**BPC1**	5.57	na	0.27	<.01	<.3	<.01	0.04	na	298	716	na	na	<DL
Sep-96	**BPC1**	3.53	na	0.17	<.01	<.3	<.01	<.01	na	205	540	na	na	0.17
Oct-96	**BPC1**	3.67	na	0.15	<.01	<.3	<.01	0.01	na	201	532	na	na	0.02
Nov-96	**BPC1**	4.36	na	0.21	<.01	<.3	<.01	0.01	na	271	792	na	na	0.04
Dec-96	**BPC1**	2.2	na	0.1	<.01	<.3	<.01	<.01	na	144	620	na	na	0.12
Jan-97	**BPC1**	3.79	na	0.22	<.01	<.3	<.01	0.04	na	213	1100	na	na	0.02
Feb-97	**BPC1**	3.62	na	0.12	0.01	<.3	<.01	0.04	na	178	692	na	na	0.06
Mar-97	**BPC1**	2.8	na	0.18	<.01	<.3	<.01	0.01	na	236	804	na	na	0.05
Apr-97	**BPC1**	3.41	na	0.23	<.01	<0	<.01	<.01	na	271	836	na	na	<DL
May-97	**BPC1**	4.61	na	0.24	<.01	<.3	<.01	0.07	na	289	916	na	na	0.07
Jun-97	**BPC1**	5.095	na	0.225	<.01	<.3	<.01	<.01	na	291	864	na	na	0.04
Jul-97	**BPC1**	5.66	na	0.25	<.01	<.3	<.01	<.01	na	303	860	na	na	<DL
Aug-97	**BPC1**	4.15	na	0.13	<.01	<.3	<.01	<.01	na	184	496	na	na	<DL
Sep-97	**BPC1**	5.52	na	0.24	<.01	<.4	<.01	<.01	na	262	744	na	na	0.02
Oct-97	**BPC1**	4.55	na	0.21	<.01	<.4	<.01	<.01	na	271	720	na	na	0.02
Nov-97	**BPC1**	4.8	na	0.26	<.01	<.3	<.01	0.05	na	288	716	na	na	<DL
Dec-97	**BPC1**	3.77	na	0.22	<.01	<.3	<.01	<.01	na	237	972	na	na	0.04
Jan-98	**BPC1**	2.34	na	0.13	<.01	<.3	<.01	0.04	na	200	1116	na	na	<DL
Feb-98	**BPC1**	2.37	na	0.17	<.01	<.2	<.01	<.01	na	210	792	na	na	<DL
Mar-98	**BPC1**	1.74	na	0.14	<.01	<.2	<.01	<.01	na	201	668	na	na	0.14
Apr-98	**BPC1**	1.25	na	0.12	<.01	<.3	<.01	<.01	na	180	600	na	na	0.03
May-98	**BPC1**	4.06	na	0.19	<.01	<.3	<.01	<.01	na	272	732	na	na	0.04
Jun-98	**BPC1**	3.87	na	0.18	<.01	<.3	<.01	0.02	na	264	636	na	na	0.04
Jul-98	**BPC1**	2.85	na	0.16	<.01	<.3	<.01	<.01	na	222	548	na	na	<DL
Aug-98	**BPC1**	3.11	na	0.12	<.01	<.3	<.01	<.01	na	165	368	na	na	0.09
Sep-98	**BPC1**	2.59	na	0.09	<.01	<.3	<.01	0.01	na	135	336	na	na	0.01
Oct-98	**BPC1**	3.17	na	0.13	<.01	<.3	<.01	0.05	na	188	460	na	na	0.12
Nov-98	**BPC1**	3.38	na	0.17	<.01	<.3	<.01	0.14	na	253	592	na	na	0.08
Dec-98	**BPC1**													
Jan-99	**BPC1**	3.35	na	0.21	<.01	<.3	<.01	<.01	na	241	1216	na	na	0.09
Feb-99	**BPC1**	3.08	na	0.21	<.01	<.3	<.01	<.01	na	250	792	na	na	0.05
Mar-99	**BPC1**	2.32	na	0.23	<.01	<.3	<.01	<.01	na	237	984	na	na	0.05
Apr-99	**BPC1**													
May-99	**BPC1**													
Jun-99	**BPC1**													
Jul-99	**BPC1**	5.68	na	0.3	<.01	<.2	<.01	<.01	na	338	720	na	na	0.04
Aug-99	**BPC1**	5.17	na	0.26	<.01	<.2	<.01	<.01	na	272	652	na	na	0.02
Sep-99	**BPC1**	2.12	na	0.13	<.01	<.3	<.01	<.01	na	121	372	na	na	0.03
Oct-99	**BPC1**	5.02	na	0.26	<.01	<.3	<.01	0.05	na	261	632	na	na	<DL
Nov-99	**BPC1**													
Dec-99	**BPC1**	2.89	na	0.28	<.01	<.5	<.01	<.01	na	224	572	na	na	0.03
Jan-00	**BPC1**	2.6	na	0.26	<.01	<.3	<.01	0.04	na	223	872	na	na	<DL
Feb-00	**BPC1**	2.47	na	0.312	<.01	<.1	<.01	0.006	na	178	1488	na	na	<DL
Mar-00	**BPC1**	1.49	na	0.37	<.01	<.1	<.01	0.002	na	222	1196	na	na	<DL
Apr-00	**BPC1**	2.47	na	0.148	<.01	<.1	<.01	0.003	na	140	720	na	na	0.05
May-00	**BPC1**	2.27	na	0.167	<.01	<.1	<.01	0.005	na	184	600	na	na	0.04
Jun-00	**BPC1**	2.4	na	0.15	<.01	<.1	<.01	0.005	na	170	488	na	na	<DL
Jul-00	**BPC1**	3.73	na	0.28	<.01	<.1	<.01	<.01	na	254	624	na	na	<DL
Aug-00	**BPC1**	3.15	na	0.251	<.01	<.3	<.01	<.005	na	222	640	na	na	0.02
Sep-00	**BPC1**	2.51	na	0.157	<.01	<.2	<.01	<.01	na	168	532	na	na	<DL
Oct-00	**BPC1**	2.89	na	0.275	<.01	<.2	<.01	<.01	na	232	640	na	na	0.02
Nov-00	**BPC1**	3.26	na	0.239	<.01	<.1	<.01	<.002	na	248	624	na	na	0.02
Dec-00	**BPC1**													
Jan-01	**BPC1**	3.11	na	0.335	<.01	<.1	<.01	<.01	na	236	1084	na	na	<DL
Feb-01	**BPC1**	2.3	na	0.128	<.01	<.1	<.01	0.01	na	158	836	na	na	0.11
Mar-01	**BPC1**	1.56	na	0.198	<.01	<.1	<.01	0.01	na	218	892	na	na	0.02
Apr-01	**BPC1**	1.22	na	0.112	<.01	<.1	<.01	0.104	na	95	908	na	na	0.05
May-01	**BPC1**	2.57	na	0.199	<.01	<.2	<.01	0.01	na	213	816	na	na	0.01
Jun-01	**BPC1**	3.29	na	0.199	<.01	<.2	<.01	<.01	na	233	768	na	na	0.02
Jul-01	**BPC1**	1.76	na	0.119	<.01	<.2	<.01	<.01	na	126	592	na	na	0.04
Aug-01	**BPC1**	3.13	na	0.166	0.01	<.1	<.01	<.01	na	191	600	na	na	0.07
Sep-01	**BPC1**	3.11	na	0.165	<.01	<.1	<.01	<.01	na	207	620	na	na	<DL
Oct-01	**BPC1**	2.43	na	0.111	<.01	<.2	<.01	0.01	na	175	484	na	na	<DL
Nov-01	**BPC1**													
Dec-01	**BPC1**	2.24	na	0.156	<.01	<.2	<.01	<.002	na	213	612	na	na	<DL
Jan-02	**BPC1**													
Feb-02	**BPC1**	2.32	na	0.234	<.01	<.2	<.01	<.001	na	242	904	na	na	0.06
Mar-02	**BPC1**	2.24	na	0.17	<.01	<.2	<.01	0.013	na	202	1016	na	na	0.02
Apr-02	**BPC1**	0.69	na	0.094	<.01	<.2	<.01	<.001	na	151	660	na	na	<DL
May-02	**BPC1**	1.33	na	0.074	<.01	<.2	<.01	0.005	na	123	488	na	na	0.05
Jun-02	**BPC1**	1.11	na	0.068	<.01	<.2	<.01	<.002	na	129	416	na	na	0.01
Jul-02	**BPC1**	1.66	na	0.107	<.01	<.2	<.01	<.002	na	242	412	na	na	<DL
Aug-02	**BPC1**	2.69	na	0.133	<.01	<.2	<.01	0.003	na	180	452	na	na	<DL
Sep-02	**BPC1**	1.14	na	0.085	<.01	<.1	<.01	<.002	na	262	600	na	na	<DL
	samples analyzed	89	na	89	89	89	89	89	na	89	89	na	na	89
	detects	89	na	89	3	1	0	42	na	89	89	na	na	64
	% detects	100	na	100	3	1	0	47	na	100	100	na	na	72
	min	0.69	na	0.068	0.01	0.4	-	0.002	na	80	336	na	na	0.01
	max	6.37	na	0.37	0.01	0.4	-	0.48	na	338	1488	na	na	0.34
	mean	3.3	na	0.2	0.01	-	-	0.05	na	226	744	na	na	0.07

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F	Cl	NO_3-N	SO_4	Hg*	La*	Sc*	Zr*	IDC*	DOC*	TDC*	Hardness*	NO2-N*
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC1**	na	292	1.76	101	0.198	<2	<3	NA	55.5	113	168	499	<DL
Apr-94	**BPC1**	na	223	0.65	115	<.05	<.002	<.003	<.01	63.8	115	179	515	<0.01
May-94	**BPC1**	na	202	0.48	125	0.109	<2	<.3	<.01	60.2	117	177	531	<0.01
Jun-94	**BPC1**	na	117	1.69	42.1	0.224	<2	<.3	<.01	9	43	51.9	104	<0.01
Jul-94	**BPC1**	na	162	0.48	128	<DL	<.005	<.005	<.01	5.6	10.9	16.5	503	<DL
Aug-94	**BPC1**	na	127	0.25	132	<DL	<.002	<.003	<.01	80.5	14.6	95.1	518	<DL
Sep-94	**BPC1**	na	117	0.27	131	<DL	<.002	<.003	NA	78	30.9	109	479	<DL
Oct-94	**BPC1**	na	104	3.09	54.6	<DL	<.002	<.003	NA	35.2	27.9	63.1	222	<DL
Nov-94	**BPC1**	na	159	3.23	94.2	<DL	<.002	<.003	<.01	64.8	12.5	77.3	408	<DL
Dec-94	**BPC1**													
Jan-95	**BPC1**	na	289	3.04	107	<DL	<.002	<.003	<.01	68.1	37.9	106	480	<DL
Feb-95	**BPC1**	na	224	1.53	101	<DL	<.005	<.005	<.01	65.6	1.2	66.8	474	<DL
Mar-95	**BPC1**	na	321	1.6	80.5	0.05	<.002	<.003	<.02	49.8	40.2	90	392	<DL
Apr-95	**BPC1**	na	185	1.69	90.7	<DL	<.002	<.003	<.02	60.4	7.9	68.3	421	<DL
May-95	**BPC1**	na	139	2.28	81.1	<DL	<.003	<.003	<.01	70.2	62.2	132.4	375	<DL
Jun-95	**BPC1**													
Jul-95	**BPC1**													
Aug-95	**BPC1**													
Sep-95	**BPC1**													
Oct-95	**BPC1**													
Nov-95	**BPC1**	na	229	2.44	135	<DL	<2	<3	<.01	54.2	22.6	76.9	488	<DL
Dec-95	**BPC1**	na	275	1.35	142	<DL	<.002	<.003	<.01	55.8	32	87.8	549	<DL
Jan-96	**BPC1**	na	303	2.2	138	<DL	<.002	<.003	<.01	56	39.4	95.5	565	<DL
Feb-96	**BPC1**	na	301	1.53	135	<DL	<.002	<.003	<.01	56.4	26.4	82.9	550	<DL
Mar-96	**BPC1**	na	166	0.87	121	<DL	<.002	<.003	<.01	66.8	56.3	123.1	540	<DL
Apr-96	**BPC1**	na	405	1.33	90.9	<DL	<.002	<.003	<.01	37.2	44.8	82	390	<DL
May-96	**BPC1**	na	246	2.36	90	<DL	<.002	<.003	<.01	38.1	40.3	78.4	389	<DL
Jun-96	**BPC1**	na	165	0.35	88.5	0.13	<.002	<.003	<.01	54.9	34.3	89.1	465	<DL
Jul-96	**BPC1**	na	116	3.11	67.1	<DL	<.002	<.003	<.01	43.2	39.7	82.8	357	<DL
Aug-96	**BPC1**	na	123	0.77	103	<DL	<.002	<.007	<.01	54.9	50.5	105.4	514	<DL
Sep-96	**BPC1**	na	103	0.8	80.4	<DL	<.002	<.003	0.01	36.4	34.1	70.4	295	<DL
Oct-96	**BPC1**	na	119	0.65	78	<DL	<.002	<.003	<.01	43.3	12.6	55.9	307	<DL
Nov-96	**BPC1**	na	176	1.12	109	<DL	<.002	<.003	<.01	55.2	23.5	78.6	445	<DL
Dec-96	**BPC1**	na	199	2.16	58.6	<DL	<.002	<.003	<.01	29.5	16.3	45.8	259	<DL
Jan-97	**BPC1**	na	394	8.96	80.8	<DL	<.002	<.003	<.01	45.6	23.1	68.7	570	0.02
Feb-97	**BPC1**	na	222	3.18	61.6	0.15	<.002	<.003	<.01	41.9	15.8	57.7	329	<DL
Mar-97	**BPC1**	na	192	1.84	88.1	<DL	<.002	<.003		53.8	16.1	69.9	425	<DL
Apr-97	**BPC1**	na	213	1.09	103	<DL	<.005	<.003		58.3	29.2	87.5	491	<DL
May-97	**BPC1**	na	179	0.74	77.3	0.1	<.005	<.003		53	31.8	84.7	480	<DL
Jun-97	**BPC1**	na	185	0.62	103	<DL	<.002	<.003		65.3	18	83.3	449	<DL
Jul-97	**BPC1**	na	143	0.47	119	<DL	<.002	<.003		62.3	47.5	109.8	508	<DL
Aug-97	**BPC1**	na	95.015	1.57	66.4	<DL	<.002	<.003		41.5	2.5	44	297	<DL
Sep-97	**BPC1**	na	146	0.4	114	<DL	<.002	<.003		58.8	32.7	91.5	467	<DL
Oct-97	**BPC1**	na	141	0.37	126	<DL	<.002	<.003		54.5	25.4	79.9	416	<DL
Nov-97	**BPC1**	na	139	0.14	130	<DL	<.002	<.003		58	50.2	108.2	490	<DL
Dec-97	**BPC1**	na	234.78	0.61	101	<DL	<.002	<.003		47.2	26.9	74.1	447	<DL
Jan-98	**BPC1**	na	373.78	2.28	86.8	<DL	<.002	<.003		37.6	11.8	49.4	297	<DL
Feb-98	**BPC1**	na	255.32	1.77	93.5	<DL	<.002	<.003		39.1	3	42.1	405	<DL
Mar-98	**BPC1**	na	210	1.47	81.5	0.07	<.002	<.003		34.5	9.9	44.4	365	<DL
Apr-98	**BPC1**	na	142	0.83	60.5	0.11	<.002	<.003		31.5	3.6	35.1	287	<DL
May-98	**BPC1**	na	142	0.89	87.5	0.32	<.002	<.003		48.6	37.9	86.5	397	<DL
Jun-98	**BPC1**	na	133	1.18	92.5	0.06	<.002	<.003		45.4	30.2	75.5	368	<DL
Jul-98	**BPC1**	na	104.6	0.52	73.7	<DL	<.002	<.003		37.2	24.5	61.7	385	<DL
Aug-98	**BPC1**	na	54.465	0.17	51.1	<DL	<.002	<.003		27.9	26.6	54.5	238	<DL
Sep-98	**BPC1**	na	59.81	0.31	47.4	0.06	<.002	<.003		22.1	26	48	202	<DL
Oct-98	**BPC1**	na	88.196	0.72	65	<DL	<.002	<.003		29.5	41	70.4	291	<DL
Nov-98	**BPC1**	na	117	0.6	86.5	0.37	<.002	<.003		38.1	70.2	108.3	393	<DL
Dec-98	**BPC1**													
Jan-99	**BPC1**	na	515	1.02	101	<DL	<.002	<.003		35.5	23.1	58.6	464	<DL
Feb-99	**BPC1**	na	213	0.83	99.4	<DL	<.002	<.003		62.2	11.8	74	433	<DL
Mar-99	**BPC1**	na	281	0.98	99	<DL	<.002	<.003		57.4	12.7	70.1	462	<DL
Apr-99	**BPC1**													
May-99	**BPC1**													
Jun-99	**BPC1**													
Jul-99	**BPC1**	na	98	0.36	81.8	<DL	<.002	<.003		79.8	15.6	95.4	469	<DL
Aug-99	**BPC1**	na	93	0.2	108	<DL	<.002	<.003		67.5	18.6	86.1	479	<DL
Sep-99	**BPC1**	na	71	0.39	55.2	0.08	<.002	<.003		26.6	25.9	52.5	205	<DL
Oct-99	**BPC1**	na	91	0.01	112	<DL	<.002	<.003		67.8	20.6	88.4	474	<DL
Nov-99	**BPC1**													
Dec-99	**BPC1**	na	120	0.3	103	<DL	<.002	<.003		49.7	22.3	72	385	<DL
Jan-00	**BPC1**	na	265	0.32	116	<DL	<.002	<.003		49.3	16.8	66	427	<DL
Feb-00	**BPC1**	na	697	0.86	96.2	<DL	<.002	<.003		37.1	21.8	58.9	464	<DL
Mar-00	**BPC1**	na	453	0.07	114	<DL	0.003	<.003		45.7	28.4	74.1	538	<DL
Apr-00	**BPC1**	na	204	1.65	78.3	<DL	<.002	<.003		28.3	22.6	50.9	304	<DL
May-00	**BPC1**	na	148	1.92	62.6	<DL	<.002	<.003		40	21.6	61.6	319	<DL
Jun-00	**BPC1**	na	110	1.4	52.1	<DL	<.002	<.003		36.6	21.7	58.3	266	<DL
Jul-00	**BPC1**	na	122	0.3	90.7	<DL	<.002	<.003		55.8	21.6	77.4	410	<DL
Aug-00	**BPC1**	na	127	0.16	86.9	<DL	<.002	<.003		49	20.8	69.8	364	<DL
Sep-00	**BPC1**	na	121	0.31	111	<DL	<.002	<.003		35.9	19.7	55.6	292	<DL
Oct-00	**BPC1**	na	150	0.05	89.6	<DL	<.002	<.003		52.3	22.7	75	404	<DL
Nov-00	**BPC1**	na	127	0.79	92.9	<DL	<.002	<.003		59.5	14.6	74	425	<DL
Dec-00	**BPC1**													
Jan-01	**BPC1**	na	363	0.41	121	<DL	<.002	<.003		63.8	10.3	74.1	538	<DL
Feb-01	**BPC1**	na	332	1.52	62.6	<DL	<.002	<.003		36.3	13.7	50	326	<DL
Mar-01	**BPC1**	na	318	0.92	96.1	<DL	<.002	<.003		55	18	73.1	475	<DL
Apr-01	**BPC1**	na	265	0.66	76.3	<DL		<.003		31.4	20.2	51.7	273	<DL
May-01	**BPC1**	na	259	0.83	83.7	0.2		<.003		50.1	37.5	87.5	413	<DL
Jun-01	**BPC1**	na	208	0.31	80.4	0.15		<.003		55.9	29.6	85.5	407	<DL
Jul-01	**BPC1**	na	187	0.2	55.2	0.13		<.003		30.7	5.7	36.4	245	<DL
Aug-01	**BPC1**	na	157	0.95	66.2	0.13		<.003		45.1	6.4	51.6	329	<DL
Sep-01	**BPC1**	na	135	0.45	63.5	<DL		<.003		49.3	5	54.3	344	<DL
Oct-01	**BPC1**	na	117	0.6	56.6	<DL		<.003		39.1	6.2	45.3	273	<DL
Nov-01	**BPC1**													
Dec-01	**BPC1**	na	149	0.37	73.5	0.11		<.003		52.8	0.4	53.2	359	<DL
Jan-02	**BPC1**													
Feb-02	**BPC1**	na	306	0.31	84.4	<DL		<.003		56.7	4.7	61.4	470	<DL
Mar-02	**BPC1**	na	367	1.24	82.5	0.06		<.003		46.7	5.3	52	411	<DL
Apr-02	**BPC1**	na	231	0.78	51.8	<DL		<.003		25.1	0.1	25.2	227	<DL
May-02	**BPC1**	na	178	0.35	41.7	<DL		<.003		20.2	4.1	24.3	175	<DL
Jun-02	**BPC1**	na	135	0.52	45.2	<DL		<.003		23	4.3	27.3	178	<DL
Jul-02	**BPC1**	na	110	0.21	44.7	<DL		<.003		30.2	2	32.2	208	<DL
Aug-02	**BPC1**	na	95	0.34	57.7	<DL		<.003		38.7	7	45.7	281	<DL
Sep-02	**BPC1**	na	115	0.24	82.7	0.08		<.003		62.1	8.2	70.4	154	<DL
	samples analyzed	na	89	89	89	89	73	89	27	89	89	89	89	89
	detects	na	89	89	89	21	1	0	1	89	89	89	89	1
	% detects	na	100	100	100	24	1	0	4	100	100	100	100	1
	min	na	54.465	0.01	41.7	0.05	0.003	-	0.01	5.6	0.1	16.5	104	0.02
	max	na	697	8.96	142	0.37	0.003	-	0.01	80.5	117	179	570	0.02
	mean	na	198	1	89	0.1	-	-	-	48	26	73	390	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC2**	7.79	1580		3		0.07	<.1	0.08	0.06	<1	108	<.01	<.01	<.01
Apr-94	**BPC2**	7.58	2053	8.4	1		<.3	<.1	0.07	0.06	<.001	107	<.01	<.01	<.01
May-94	**BPC2**	7.80	1676	14.8	1		0.06	<.1	0.07	0.06	<1	110	<.01	<.01	<.01
Jun-94	**BPC2**	7.79	526	20.0	>200		0.24	<.1	0.05	<DL	<1	31.2	<.01	<.01	<.01
Jul-94	**BPC2**	7.86	1437	14.6	2		<.02	<.1	<.02	<DL	<.001	105	<.02	<.02	<.01
Aug-94	**BPC2**	7.85	1375	15.3	1		0.05	<.1	0.1	0.06	<.001	115	<.01	<.01	<.01
Sep-94	**BPC2**	7.76	1480	12.9	1		<.02	<.1	0.1	0.06	<.001	114	<.01	<.01	0.01
Oct-94	**BPC2**	7.92	940	7.3	30		0.1	<.1	<.02	0.04	<.001	52.2	<.01	<.01	<.01
Nov-94	**BPC2**	8.13	1878	3.6	13		0.03	<.1	0.06	0.05	<.001	82.9	<.01	<.01	<.01
Dec-94	**BPC2**														
Jan-95	**BPC2**	8.07	2934	1.9	2		<.03	<.1	0.1	0.07	<.001	105	<.01	<.01	<.01
Feb-95	**BPC2**	7.78	2287	4.7	1		0.03	<.1	0.05	0.06	<.002	104	<.01	<.01	<.01
Mar-95	**BPC2**	7.53	2394	6.3	24		<.02	<.1	0.07	0.06	<.001	96.7	<.01	<.01	<.01
Apr-95	**BPC2**	8.33	1661	11.9	1		<.02	<.1	0.07	0.05	<.001	84.6	<.01	0.01	<.01
May-95	**BPC2**	8.04	1288	17.2	1		0.05	<.1	0.06	0.05	<.001	87	<.01	<.01	<.01
Jun-95	**BPC2**														
Jul-95	**BPC2**														
Aug-95	**BPC2**														
Sep-95	**BPC2**														
Oct-95	**BPC2**														
Nov-95	**BPC2**	7.49	2473	4.5	1		0.04	<.1	0.07	0.06	<1	108	<.01	<.01	<.01
Dec-95	**BPC2**	7.63	2584	6.2	0		0.03	<.1	0.09	0.07	0.002	128	<.01	<.01	<.01
Jan-96	**BPC2**	7.75	3769	1.8	21		<.02	<.1	0.04	0.06	0.002	122	<.01	<.01	<.01
Feb-96	**BPC2**	7.82	3503	3.9	1		<.01	<.1	0.07	0.07	<.002	121	<.01	<.01	<.01
Mar-96	**BPC2**	7.71	3876	5.9	0		0.05	<.1	0.04	0.06	<.001	110	<.01	<.01	<.01
Apr-96	**BPC2**	8.12	2433	12.7	6		<.02	<.1	0.05	0.09	<.001	89.3	<.01	<.01	<.01
May-96	**BPC2**	8.04	1248	18.3	2		0.04	<.1	0.11	0.09	<.001	85	<.01	<.01	<.01
Jun-96	**BPC2**	8.22	1530	17.2	3		0.03	<.1	0.1	0.06	<.001	102	<.01	<.01	<.01
Jul-96	**BPC2**	7.89	1230	19.0	71		<.02	<.1	0.1	0.06	<.001	83.9	<.01	<.01	<.01
Aug-96	**BPC2**	7.86	1460	15.5	1		<DL	<.1	0.11	0.07	<.001	120	<.01	<.01	<.01
Sep-96	**BPC2**	7.45	415	16.1	1600		0.04	<.1	0.06	<DL	<.001	45.1	<.01	<.01	<.01
Oct-96	**BPC2**	7.43	626	11.8	45		<.03	<.1	0.08	0.04	<.001	68.4	<.01	<.01	<.01
Nov-96	**BPC2**	7.55	766	6.6	4		<.02	<.1	0.07	0.05	<.001	100	<.01	<.01	<.01
Dec-96	**BPC2**	7.63	547	4.4	1822		<.01	<.1	0.03	0.05	<.001	60.2	<.01	<.01	<.01
Jan-97	**BPC2**	8.02	1588				0.05	<.1	0.05	0.07	<.001	108	<.01	<.01	<.01
Feb-97	**BPC2**	7.98	562	0.7	116		0.14	<.2	0.06	0.05	<.001	74.6	<.01	<.01	<.01
Mar-97	**BPC2**	8.14	877	8.2	6		<.02	<.1	0.06	0.06	<DL	98.9	<.01	<.01	<.01
Apr-97	**BPC2**	7.90	978	10.6	2		<.03	<.1	0.06	0.06	<.001	103	<.01	<.01	<.01
May-97	**BPC2**	7.72	842	9.9	2		<.04	<.2	0.11	0.06	<.002	106	<.01	<.01	<.01
Jun-97	**BPC2**	7.68	851	12.3	4		<.02	<.1	0.07	0.06	<.002	101	0.02	<.01	<.01
Jul-97	**BPC2**	7.55	1090	13.8	2		<.02	<.1	0.08	0.06	<.001	109	<.01	<.01	<.01
Aug-97	**BPC2**	7.97	636	17.3	71		0.16	<.1	0.07	0.05	<.001	66	<.01	<.01	<.01
Sep-97	**BPC2**	7.84	791	12.4	4		<.02	<.2	0.1	0.06	<.001	103	<.01	<.01	<.01
Oct-97	**BPC2**	7.82	729	11.1	6		0.03	<.2	0.09	0.06	<.001	94.2	<.01	<.01	<.01
Nov-97	**BPC2**	7.74	1171	8.0	1		0.04	<.3	0.09	0.06	<.002	109	<.01	<.01	<.01
Dec-97	**BPC2**	7.76	957	5.4	8		<.02	<.3	0.07	0.06	<.002	105	<.01	<.01	<.01
Jan-98	**BPC2**	8.11	1652	1.9	58		<.02	<.1	0.06	0.07	<.001	95.6	<.01	<.01	<.01
Feb-98	**BPC2**	8.34	1269	7.6	15		<.02	<.2	0.05	0.05	<.001	88.4	<.01	<.01	<.01
Mar-98	**BPC2**	8.44	1280	13.8	16		<.02	<.1	0.06	0.05	<.001	82.4	<.01	<.01	<.01
Apr-98	**BPC2**	8.07	777	13.6	30		0.03	<.1	0.04	0.04	<.001	63.4	<.01	<.01	<.01
May-98	**BPC2**	7.79	978	14.3	4		<.02	<.1	0.07	0.05	<.001	87.1	<.01	<.01	<.01
Jun-98	**BPC2**	7.67	875	17.6	6		<.02	<.1	0.09	0.06	<.001	87.4	<.01	<.01	<.01
Jul-98	**BPC2**	7.68	774	20.6	16		<.02	<.1	0.08	0.05	<.001	72.1	<.02	<.01	<.01
Aug-98	**BPC2**	7.58	568	21.2	26		0.04	<.1	0.06	<DL	<.001	53	<.02	<.01	<.01
Sep-98	**BPC2**	8.20	543	20.9	63		0.05	<.1	0.08	<DL	<.003	45.2	<.01	<.01	<.01
Oct-98	**BPC2**	7.99	780	14.9	55		0.03	<.1	0.08	0.05	<.001	66.1	<.01	<.01	<.01
Nov-98	**BPC2**	7.67	919	8.4	13		0.04	<.1	0.1	0.06	<.001	90.8	<.01	<.01	<.01
Dec-98	**BPC2**														
Jan-99	**BPC2**	6.66	2072	3.3	9		<.01	<.1	0.05	0.09	<.001	110	<.01	<.01	<.01
Feb-99	**BPC2**	6.33	1239	4.2	6		<.01	<.1	0.06	0.06	<DL	97	<.01	<.01	<.01
Mar-99	**BPC2**	6.70	1449	6.3	6		<.01	<.1	0.07	0.07	<.002	103	<.01	<.01	<.01
Apr-99	**BPC2**														
May-99	**BPC2**														
Jun-99	**BPC2**														
Jul-99	**BPC2**	7.62	956	17.7	6		<.02	<.1	0.11	0.06	<.001	99.5	<.01	<.01	<.01
Aug-99	**BPC2**	7.30		17.4	2		<.02	<.1	0.09	0.06	<.003	109	<.01	<.01	<.01
Sep-99	**BPC2**	7.58	508	15.5	49		0.05	<.1	0.07	<DL	<.001	45.5	<.01	<.01	<.01
Oct-99	**BPC2**	7.60		10.6			0.02	<.1	0.1	0.06	<.002	105	<.01	<.01	<.01
Nov-99	**BPC2**														
Dec-99	**BPC2**	7.58	1040	8.2	0		0.03	<.2	0.07	0.05	<.001	108	<.01	<.01	<.01
Jan-00	**BPC2**	7.78	1493	3.4	6		<.02	<.2	0.06	0.055	<.001	94.8	<.01	<.01	<.01
Feb-00	**BPC2**	7.96	2792	4.0	78		<DL	<.2	0.06	0.082	<.001	110	<.01	<.01	<.01
Mar-00	**BPC2**	8.05	2143	7.4	4		<.01	<.1	0.06	0.079	<.001	117	<.02	<.01	<.01
Apr-00	**BPC2**	8.23	1165	11.8	44		<DL	<.1	0.07	0.042	<.001	70.8	<.01	<.01	<.01
May-00	**BPC2**	8.02	970	16.6	74		<.02	<.1	0.06	0.051	<.001	72	<.01	<.01	<.01
Jun-00	**BPC2**	8.21	794	22.6	125		<.01	<.1	0.08	0.043	<.001	59.8	<.01	<.01	<.01
Jul-00	**BPC2**	7.93	1027	17.3	8		<.01	<.1	0.08	0.058	<.001	89.7	<.01	<.01	<.01
Aug-00	**BPC2**	7.85	967	18.2	11		<.01	<.2	0.094	0.056	<.001	75.2	<.01	<.01	<.01
Sep-00	**BPC2**	7.89	848	13.7	18		<.1	<.2	0.08	0.031	<.001	61.9	<.01	<.01	<.01
Oct-00	**BPC2**	7.55	1112	15.3	4		<.1	<.2	0.1	0.057	<.001	89.2	<.01	<.01	<.01
Nov-00	**BPC2**	7.56	1063	2.9	13		<.02	<.05	0.071	0.052	<.001	96.7	<.01	<.01	<.01
Dec-00	**BPC2**														
Jan-01	**BPC2**	7.43	1924	2.3	3		<.3	<.1	0.08	0.069	<.001	123	<.01	<.01	<.01
Feb-01	**BPC2**	7.46	1527	2.1	80		<.3	<.1	0.04	0.046	<.001	73.5	<.01	<.01	<.01
Mar-01	**BPC2**	7.78	1617	6.6	4		<.3	<.1	0.07	0.059	<.001	104	<.01	<.01	<.01
Apr-01	**BPC2**	8.19	1385	16.1	28		<.02	<.1	0.04	0.025	<.001	49.2	<.01	<.01	<.01
May-01	**BPC2**	7.84	1427	11.8	19		<DL	<.1	0.08	0.056	<.001	87.3	<.01	<.01	<.01
Jun-01	**BPC2**	7.62	1296	16.4	20		<.01	<.1	<.01	0.055	<.001	88.8	<.01	<.01	<.01
Jul-01	**BPC2**	7.83	989	24.0	24		<DL	<.1	0.06	0.042	<.001	52.3	<.01	<.01	<.01
Aug-01	**BPC2**	7.37	989	18.0	7		<DL	<.2	0.08	0.049	<.001	71.9	<.01	<.01	<.01
Sep-01	**BPC2**	7.46	923	12.9	10		<DL	<.2	0.06	0.047	<.001	74.2	<.01	<.01	<.01
Oct-01	**BPC2**	7.82	887	8.9	18		<.02	<.2	0.08	0.035	<.003	57.9	<.01	<.01	<.04
Nov-01	**BPC2**														
Dec-01	**BPC2**	7.63	991	3.0	6		<.02	<.2	0.08	0.048	<.003	80.4	<.01	<.01	<.04
Jan-02	**BPC2**														
Feb-02	**BPC2**	7.17	1608	4.0	2		<.02	<.1	0.08	0.069	<.001	108	<.01	<.01	<.01
Mar-02	**BPC2**	7.55	1708	5.5	25		<.02	<.1	0.08	0.06	0.007	102	<.01	0.02	0.01
Apr-02	**BPC2**	8.05	1495	11.5	17		<.1	<.1	0.06	0.031	<.001	47.2	<.01	<.01	<.01
May-02	**BPC2**	7.09	994	14.7	32		<.1	<.1	0.05	0.018	<.001	23.3	<.01	<.01	<.01
Jun-02	**BPC2**	7.34	814	18.0	520		<.02	<.1	0.03	0.024	<.002	33.5	<.01	<.01	<.01
Jul-02	**BPC2**	7.97	1141	18.6	21		<.02	<.1	0.04	0.023	<.002	44	<.01	<.01	<.01
Aug-02	**BPC2**	7.73	744	19.9	37		<.02	<.1	0.03	0.044	<.002	64.2	<.01	<.01	<.01
Sep-02	**BPC2**	7.41	976	15.6	1		<.01	<.1	0.08	0.02	<.001	40.2	<.01	<.01	<.01
	samples analyzed						89	89	89	89	89	89	89	89	89
	detects						27	0	86	83	3	89	1	2	2
	% detects						30	0	97	93	3	100	1	2	2
	min	6.33	415	0.7	0		0.02	-	0.03	0.018	0.002	23.3	0.02	0.01	0.01
	max	8.44	3876	24.0	1822		0.24	-	0.11	0.09	0.007	128	0.02	0.02	0.01
	mean	7.75	1339	11	64		0.06	-	0.07	0.06	0.004	86.4	na	0.02	0.01

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC2**	<.01	0.05	2	0.01	55.0	0.03	<.01	149	<.03	<DL	<.08	na	<.1	<.1
Apr-94	**BPC2**	<.01	<.01	4	0.01	60.1	0.02	<.01	109	<.03	<.01	<.08	na	<.1	<.1
May-94	**BPC2**	<.01	<DL	2	<.01	62.0	0.03	<.01	109	<.03	0.01	<.08	na	<.1	<.1
Jun-94	**BPC2**	<.01	0.17	<1	<.01	15.2	0.11	<.01	61.5	<.03	0.02	<.08	na	<.1	<.1
Jul-94	**BPC2**	<.01	0.05	<1	<.01	57.0	0.01	<.02	75.2	<.04	0.02	<.04	na	<.2	<.2
Aug-94	**BPC2**	<.01	<DL	3	0.01	60.7	0.02	<.02	63.5	<.03	0.14	<.08	na	<.1	<.1
Sep-94	**BPC2**	<.01	<DL	2	0.01	58.9	0.02	<.02	59.7	<.03	0.05	<.05	na	<.1	<.2
Oct-94	**BPC2**	<.01	0.14	5	0.01	23.0	0.03	<.02	59.8	<.03	0.14	<.05	na	<.2	<.2
Nov-94	**BPC2**	<.01	<.01	2	<.01	39.7	0.01	<.02	68	<.03	0.04	<.06	na	<.1	<.2
Dec-94	**BPC2**														
Jan-95	**BPC2**	<.01	<DL	3	<.01	50.0	0.03	<.02	158	<.03	0.06	<.05	na	<.3	<.1
Feb-95	**BPC2**	<.01	<.01	2	0.01	51.9	0.01	<.02	111	<.02	0.02	<.04	na	<.1	<.1
Mar-95	**BPC2**	<.01	<.01	4	<.01	45.8	0.04	<.02	169	<.03	0.04	<.05	na	<.2	<.1
Apr-95	**BPC2**	<.01	0.04	<1	<.01	44.9	0.01	<DL	90.4	<.03	0.02	<.05	na	<.2	<.1
May-95	**BPC2**	<.01	<.01	<1	<.01	43.3	<.01	<.02	71.4	<.03	0.01	<.08	na	<.1	<.1
Jun-95	**BPC2**														
Jul-95	**BPC2**														
Aug-95	**BPC2**														
Sep-95	**BPC2**														
Oct-95	**BPC2**														
Nov-95	**BPC2**	<DL	<.01	<1	<.01	52.6	0.02	<.02	134	<.03	0.02	<.05	na	<.2	<.2
Dec-95	**BPC2**	<.01	<.01	5	0.01	62.7	0.01	<.02	129	<.03	0.01	<.05	na	<.2	<.1
Jan-96	**BPC2**	<.01	<.01	3	0.01	58.0	0.01	<.02	140	<.03	0.01	<.05	na	<.2	<.1
Feb-96	**BPC2**	<.01	0.05	4	<.01	58.2	0.01	<.02	149	<.03	0.02	<.08	na	<.1	<.1
Mar-96	**BPC2**	<.01	0.04	3	0.01	54.2	0.02	<.02	204	<.03	<DL	<.04	na	<.1	<.1
Apr-96	**BPC2**	<.01	<.01	2	<.01	42.4	0.01	<.02	220	<.03	0.05	<.05	na	<.1	<.2
May-96	**BPC2**	<.01	<.01	<1	<.01	43.4	<.01	<.02	140	<.03	0.02	<.05	na	<.2	<.1
Jun-96	**BPC2**	0.11	<.01	<1	<.01	48.4	0.01	<.02	93.9	<.03	0.02	<.05	na	<.2	<.2
Jul-96	**BPC2**	0.04	<.01	3	<.01	37.3	0.01	<.02	70.7	<.03	<DL	<.04	na	<.2	<.2
Aug-96	**BPC2**	<.01	<.01	<1	<.03	55.9	0.02	<.02	74.2	<.03	0.03	<.05	na	<.2	<.2
Sep-96	**BPC2**	<DL	<.01	9	<.01	20.2	0.03	<.02	24.5	<.03	0.23	<.05	na	<.2	<.2
Oct-96	**BPC2**	<DL	<.01	4	<.01	32.0	<.01	<.02	65.8	<.03	0.06	<.05	na	<.2	<.2
Nov-96	**BPC2**	<DL	<.01	3	<.01	47.9	0.01	<.02	90.3	<.03	0.02	<.04	na	<.2	<.2
Dec-96	**BPC2**	0.02	<.03	3	<.01	25.6	<.01	<.02	100	<.03	0.1	<.05	na	<.2	<.2
Jan-97	**BPC2**	0.04	<.1	4	<.01	48.1	0.02	<.02	244	<.03	0.08	<.05	na	<.2	<.2
Feb-97	**BPC2**	0.02	<.03	3	<.01	34.0	<.01	<.02	128	<.03	0.06	<.05	na	<.2	<.2
Mar-97	**BPC2**	0.02	<.01	3	<.01	46.3	<.01	<.02	114	<.03	0.03	<.05	na	<.2	<.2
Apr-97	**BPC2**	<.01	<DL	3	<.01	52.1	0.01	<.01	119	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC2**	<.02	<.01	2	<.01	52.7	0.02	<.02	114	<.03	0.01	<.05	na	<.2	<.2
Jun-97	**BPC2**	<.02	<.01	2	<.01	50.1	0.01	<.02	106	<.03	0.05	<.05	na	<.2	<.1
Jul-97	**BPC2**	<.01	<.01	4	<.01	51.7	0.01	<.01	79.5	<.03	<DL	<.05	na	<.2	<.2
Aug-97	**BPC2**	<.01	0.11	<1	<.01	28.5	<.01	<.02	59.7	<.03	<DL	<.05	na	<.2	<.2
Sep-97	**BPC2**	<.01	<.01	4	0.01	47.1	<.01	<.02	68.7	<.03	<DL	<.05	na	<.2	<.1
Oct-97	**BPC2**	<.01	<.01	3	0.01	42.1	<.01	<.02	55.1	<.03	<DL	<.05	na	<.2	<.1
Nov-97	**BPC2**	<.02	<.01	2	0.01	51.3	0.01	<.02	73.7	<.03	0.02	<.05	na	<.2	<.2
Dec-97	**BPC2**	<.02	<.01	4	0.01	47.9	0.01	0.34	131	0.04	0.03	<.05	na	<.2	<.2
Jan-98	**BPC2**	<.01	<.01	3	0.01	41.8	0.01	<.02	235	<.03	0.03	<.05	na	<.1	<.2
Feb-98	**BPC2**	<.01	<.02	2	<.01	41.2	0.01	<.02	140	<.03	<DL	<.05	na	<.2	<.1
Mar-98	**BPC2**	<.01	<.01	3	0.01	38.6	<.01	<.01	120	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC2**	<.01	<.01	2	<.01	30.5	<.01	<.02	87.9	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC2**	<.01	<.01	3	<.01	41.3	0.01	<.02	81.3	<.03	<DL	<.05	na	<.1	<.2
Jun-98	**BPC2**	<.01	<.01	3	<.01	41.2	0.01	<.02	80.1	<.03	0.03	<.05	na	<.1	<.2
Jul-98	**BPC2**	<.03	<.01	<2	<.02	34.5	<.01	<.02	62	<.03	0.06	<.05	na	<.3	<.2
Aug-98	**BPC2**	<.03	0.04	<2	<.02	23.5	<.01	<.02	34.7	<.03	0.04	<.05	na	<.3	<.2
Sep-98	**BPC2**	<.01	0.05	4	<.01	19.4	<.01	0.08	39.5	<.03	0.04	<.07	na	<.2	<.1
Oct-98	**BPC2**	<.01	<DL	3	<.01	29.4	<.01	<.02	58	<.03	0.03	<.05	na	<.2	<.2
Nov-98	**BPC2**	<.01	<DL	4	<.01	42.1	0.01	<.02	75.2	<.03	0.04	<.05	na	<.2	<.2
Dec-98	**BPC2**														
Jan-99	**BPC2**	<.01	<.01	2	<.01	49.5	0.02	0.03	301	<.03	<DL	<.05	na	<.2	<.1
Feb-99	**BPC2**	<.01	<.01	5	<.01	45.9	<.01	<.02	118	<.03	<DL	0.06	na	<.2	<.2
Mar-99	**BPC2**	<.01	<.01	4	<.01	50.4	<.01	<.02	179	<.03	<DL	0.07	na	<.2	<.2
Apr-99	**BPC2**														
May-99	**BPC2**														
Jun-99	**BPC2**														
Jul-99	**BPC2**	<.01	<.01	3	0.01	47.9	<.01	<.02	65.6	<.03	0.05	<.05	na	<.1	<.1
Aug-99	**BPC2**	<.01	<.01	<1	<.01	51.9	0.02	<.02	54	<.02	0.02	<.05	na	<.2	<.2
Sep-99	**BPC2**	<.01	<DL	3	<.05	21.9	<.01	<.02	34.1	<.03	0.13	<.05	na	<.3	<.2
Oct-99	**BPC2**	<.01	<.01	3	<.01	50.3	0.01	<.02	52.6	<.03	0.06	<.05	na	<.3	<.2
Nov-99	**BPC2**														
Dec-99	**BPC2**	<.01	<DL	3	0.01	50.5	0.01	<.02	56.6	0.05	0.13	<.05	na	<.1	<.2
Jan-00	**BPC2**	<.01	<.01	4	<.01	42.7	<.01	<.02	144	<.1	0.05	<.05	na	<.2	<.2
Feb-00	**BPC2**	<.01	0.01	6	0.01	44.9	0.004	<.02	408	<.01	0.06	<.02	na	<.05	<.05
Mar-00	**BPC2**	<.01	<.01	2	0.01	57.2	0.003	<.01	276	<.01	0.07	<.03	na	<.1	<.1
Apr-00	**BPC2**	<.01	<.01	4	<.01	38.2	0.004	<.01	130	<.01	<DL	<.02	na	<.1	<.1
May-00	**BPC2**	<.01	0.02	3	<.01	32.6	0.001	<.01	95.2	<.01	0.01	<.02	na	<.1	<.1
Jun-00	**BPC2**	0.003	0.01	3	<DL	27.7	0.003	<.01	73.7	<.01	<DL	<.03	na	<.1	<.1
Jul-00	**BPC2**	<.01	<.01	3	0.01	43.1	0.011	<.02	73.3	<.01	0.04	<.02	na	<.1	<.1
Aug-00	**BPC2**	<.001	0.01	4	0.01	38.8	0.01	<.03	79.8	<.01	<DL	<.03	na	<.1	<.1
Sep-00	**BPC2**	<.01	<.01	4	<.01	36.5	0.008	<.02	57.7	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC2**	<.01	0.02	<1	0.01	44.9	0.003	<.02	84.1	<.01	<DL	<.03	na	<.2	<.2
Nov-00	**BPC2**	<.005	<.01	3	0.01	46.2	0.001	<.01	82.6	<.01	<DL	<.02	na	<.1	<.1
Dec-00	**BPC2**														
Jan-01	**BPC2**	<.003	<.01	6	<.01	54.4	0.012	<.02	218	<.01	<DL	<.05	na	<.1	<.1
Feb-01	**BPC2**	<.003	0.02	5	<.01	32.1	0.002	<.02	209	<.01	0.02	<.05	na	<.1	<.1
Mar-01	**BPC2**	<.003	<.01	4	<.01	52.5	<.001	<.02	198	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC2**	<.01	<.01	4	<.01	32.5	<.002	<.02	148	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC2**	<.01	0.02	4	0.01	44.8	<.003	<.02	170	<.01	<DL	<.05	na	<.1	<.1
Jun-01	**BPC2**	<.01	<.01	4	0.01	42.9	<.002	<.02	137	<.01	<DL	<.05	na	<.1	<.1
Jul-01	**BPC2**	<.01	<.01	4	<.01	26.3	<.002	<.02	121	0.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC2**	<.01	<.01	4	0.01	34.8	0.006	<.01	90	<.01	<DL	<.05	na	<.1	<.1
Sep-01	**BPC2**	<.01	<.01	4	<.01	34.6	<.004	<.01	85.2	<.01	<DL	<.05	na	<.1	<.1
Oct-01	**BPC2**	0.003	0.01	5	<.01	30.3	0.004	<.01	73	<.01	<DL	<.02	na	<.1	<.2
Nov-01	**BPC2**														
Dec-01	**BPC2**	<.003	<.01	2	<.01	36.3	0.002	<.01	94.2	<.01	<DL	<.02	na	<.1	<.2
Jan-02	**BPC2**														
Feb-02	**BPC2**	<.002	0.03	<1	0.01	49.5	0.007	<.05	180	<.01	0.03	<.03	na	<.1	<.1
Mar-02	**BPC2**	0.012	<.01	<1	0.01	38.7	0.009	<.05	227	<.01	0.03	<.03	na	<.1	<.1
Apr-02	**BPC2**	0.01	0.01	4	0.01	27.8	0.008	<.01	158	<.01	0.07	<.02	na	<.1	<.1
May-02	**BPC2**	<.01	<.01	3	<.01	15.5	0.007	<.01	90.7	<.01	0.01	<.02	na	<.1	<.1
Jun-02	**BPC2**	<.01	<.01	<1	<.01	22.8	0.013	<.01	78.2	<.01	0.02	<.05	na	<.1	<.1
Jul-02	**BPC2**	<.01	<.01	2	<.01	28.3	0.005	<.01	65.9	<.01	0.03	<.05	na	<.1	<.1
Aug-02	**BPC2**	<.01	<.01	3	<.01	26.8	0.007	<.01	54.5	<.01	0.03	<.05	na	<.1	<.1
Sep-02	**BPC2**	<.01	<.01	<1	<.01	27.1	0.005	<.01	42	<.01	<DL	<.05	na	<.1	<.1
	samples analyzed	89	89	89	89	89	89	89	89	89	89	89	na	89	89
	detects	10	20	72	29	89	63	3	89	3	58	2	na	0	0
	% detects	11	22	81	33	100	71	3	100	3	65	2	na	0	0
	min	0.003	0.01	2	0.01	15.2	0.001	0.03	24.5	0.01	0.01	0.06	na	-	-
	max	0.11	0.17	9	0.01	62.7	0.11	0.34	408	0.05	0.23	0.07	na	-	-
	mean	0.03	0.05	3	0.01	41.8	0.01	0.2	113	0.03	0.05	0.07	na	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC2**	3.74	na	0.18	<.01	<.1	<.01	<.01	na	275	980	na	na	<DL
Apr-94	**BPC2**	3.55	na	0.23	<.01	<.3	<.01	<.01	na	288	936	na	na	0.08
May-94	**BPC2**	4.64	na	0.25	<.01	<.3	<.01	0.07	na	279	856	na	na	0.04
Jun-94	**BPC2**	2.28	na	0.08	0.01	<.3	<.01	<.01	na	78	396	na	na	0.27
Jul-94	**BPC2**	5.5	na	0.01	<.01	<.2	<.01	<.02	na	290	812	na	na	0.04
Aug-94	**BPC2**	6.56	na	0.28	<.01	<.3	<.01	<.01	na	308	808	na	na	0.06
Sep-94	**BPC2**	6.59	na	0.28	<.01	<.3	<.01	<.01	na	308	804	na	na	0.06
Oct-94	**BPC2**	3.22	na	0.11	0.01	<.4	<.01	0.01	na	128	624	na	na	0.04
Nov-94	**BPC2**	4.2	na	0.14	<.01	<.3	<.01	0.01	na	253	820	na	na	<DL
Dec-94	**BPC2**													
Jan-95	**BPC2**	3.65	na	0.18	<.01	0.6	<.01	<.01	na	265	1060	na	na	0.14
Feb-95	**BPC2**	3.56	na	0.2	<.01	<.2	<.01	0.12	na	267	856	na	na	0.02
Mar-95	**BPC2**	2.33	na	0.15	<.01	<.4	<.01	0.1	na	216	912	na	na	0.07
Apr-95	**BPC2**	2.16	na	0.16	<.01	<.4	<.01	0.05	na	238	764	na	na	0.01
May-95	**BPC2**	4.29	na	0.15	<.01	<.3	<.01	0.34	na	286	708	na	na	0.06
Jun-95	**BPC2**													
Jul-95	**BPC2**													
Aug-95	**BPC2**													
Sep-95	**BPC2**													
Oct-95	**BPC2**													
Nov-95	**BPC2**	4.65	na	0.24	0.01	<.4	<.01	0.01	na	268	936	na	na	0.04
Dec-95	**BPC2**	4.76	na	0.29	<.01	<.3	<.01	<.01	na	277	1084	na	na	0.04
Jan-96	**BPC2**	4.08	na	0.25	<.01	<.6	<.01	<.01	na	260	1144	na	na	0.11
Feb-96	**BPC2**	3.84	na	0.25	<.01	<.3	<.01	<.01	na	266	1088	na	na	0.07
Mar-96	**BPC2**	2.99	na	0.24	<.01	<.3	<.01	0.04	na	248	1224	na	na	0.02
Apr-96	**BPC2**	2.43	na	0.18	<.01	<.3	<.01	<.01	na	202	1188	na	na	0.04
May-96	**BPC2**	2.89	na	0.17	<.01	<1	0.01	0.02	na	235	888	na	na	0.02
Jun-96	**BPC2**	4.61	na	0.19	<.01	<.6	<.01	0.08	na	277	764	na	na	0.03
Jul-96	**BPC2**	4.64	na	0.13	<.01	<.2	<.01	0.03	na	233	664	na	na	0.04
Aug-96	**BPC2**	5.75	na	0.28	<.01	<.3	<.01	0.02	na	317	724	na	na	0.02
Sep-96	**BPC2**	2.52	na	0.1	<.01	<.3	<.01	0.01	na	156	368	na	na	0.05
Oct-96	**BPC2**	3.62	na	0.15	<.01	<.3	<.01	<.01	na	201	532	na	na	0.01
Nov-96	**BPC2**	4.37	na	0.21	<.01	<.3	<.01	<.01	na	267	820	na	na	0.06
Dec-96	**BPC2**	2.13	na	0.1	<.01	<.3	<.01	0.01	na	131	608	na	na	0.11
Jan-97	**BPC2**	3.77	na	0.19	<.01	<.3	<.01	0.01	na	210	1108	na	na	<DL
Feb-97	**BPC2**	3.56	na	0.12	<.01	<.3	<.01	0.01	na	174	720	na	na	0.09
Mar-97	**BPC2**	2.9	na	0.18	<.01	<.3	<.01	0.02	na	232	756	na	na	0.05
Apr-97	**BPC2**	3.42	na	0.21	<.01	<0	<.01	<.01	na	264	840	na	na	<DL
May-97	**BPC2**	4.67	na	0.24	<.01	<.3	<.01	0.03	na	289	912	na	na	0.02
Jun-97	**BPC2**	5.07	na	0.23	<.01	<.3	<.01	<.01	na	289	852	na	na	0.03
Jul-97	**BPC2**	5.57	na	0.25	<.01	<.3	<.01	0.06	na	308	852	na	na	<DL
Aug-97	**BPC2**	4.21	na	0.12	<.01	<.3	<.01	<.01	na	175	504	na	na	<DL
Sep-97	**BPC2**	5.61	na	0.23	<.01	<.4	<.01	<.01	na	267	748	na	na	0.01
Oct-97	**BPC2**	4.66	na	0.21	<.01	<.4	<.01	0.09	na	260	724	na	na	0.02
Nov-97	**BPC2**	5.36	na	0.26	<.01	<.3	<.01	0.03	na	287	728	na	na	<DL
Dec-97	**BPC2**	3.76	na	0.23	<.01	<.3	<.01	0.02	na	228	880	na	na	0.04
Jan-98	**BPC2**	3.14	na	0.18	<.01	<.3	<.01	<.01	na	193	1072	na	na	0.03
Feb-98	**BPC2**	2.26	na	0.16	<.01	<.2	<.01	0.04	na	204	796	na	na	0.02
Mar-98	**BPC2**	1.79	na	0.14	<.01	<.2	<.01	<.01	na	196	676	na	na	0.06
Apr-98	**BPC2**	1.33	na	0.12	<.01	<.3	<.01	<.01	na	174	600	na	na	0.03
May-98	**BPC2**	3.92	na	0.18	<.01	<.3	<.01	<.01	na	260	728	na	na	0.06
Jun-98	**BPC2**	3.97	na	0.18	<.01	<.3	<.01	<.01	na	250	688	na	na	0.02
Jul-98	**BPC2**	2.91	na	0.16	<.01	<.3	<.01	<.01	na	215	572	na	na	<DL
Aug-98	**BPC2**	2.97	na	0.11	<.01	<.3	0.01	<.01	na	158	360	na	na	0.04
Sep-98	**BPC2**	2.49	na	0.09	<.01	<.3	<.01	0.18	na	130	324	na	na	0.01
Oct-98	**BPC2**	3.03	na	0.13	<.01	<.3	<.01	<.01	na	185	460	na	na	0.09
Nov-98	**BPC2**	3.37	na	0.18	<.01	<.3	<.01	0.39	na	252	608	na	na	0.09
Dec-98	**BPC2**													
Jan-99	**BPC2**	3.44	na	0.22	<.01	<.3	<.01	<.01	na	240	1252	na	na	0.14
Feb-99	**BPC2**	3.18	na	0.2	<.01	<.3	<.01	<.01	na	250	780	na	na	0.04
Mar-99	**BPC2**	2.29	na	0.23	<.01	<.3	<.01	<.01	na	242	1012	na	na	0.03
Apr-99	**BPC2**													
May-99	**BPC2**													
Jun-99	**BPC2**													
Jul-99	**BPC2**	4.41	na	0.23	<.01	<.2	<.01	<.01	na	298	716	na	na	0.04
Aug-99	**BPC2**	5.1	na	0.27	<.01	<.2	<.01	0.02	na	304	664	na	na	0.02
Sep-99	**BPC2**	2.04	na	0.13	<.01	<.3	0.01	<.01	na	121	380	na	na	0.07
Oct-99	**BPC2**	5.08	na	0.26	<.01	<.3	<.01	<.01	na	281	628	na	na	<DL
Nov-99	**BPC2**													
Dec-99	**BPC2**	5.5	na	0.31	<.01	<.5	<.01	0.09	na	330	632	na	na	<DL
Jan-00	**BPC2**	2.4	na	0.26	<.01	<.3	<.01	<.01	na	213	888	na	na	<DL
Feb-00	**BPC2**	2.45	na	0.31	<.01	<.1	<.01	0.08	na	170	1508	na	na	<DL
Mar-00	**BPC2**	1.5	na	0.373	<.01	<.1	<.01	0.003	na	220	1200	na	na	<DL
Apr-00	**BPC2**	2.35	na	0.162	<.01	<.1	<.01	0.008	na	176	760	na	na	0.01
May-00	**BPC2**	2.26	na	0.164	<.01	<.1	<.01	0.003	na	179	568	na	na	0.01
Jun-00	**BPC2**	2.29	na	0.149	<.01	<.1	<.01	0.002	na	176	492	na	na	<DL
Jul-00	**BPC2**	3.49	na	0.285	<.01	<.1	<.01	<.01	na	249	616	na	na	<DL
Aug-00	**BPC2**	2.83	na	0.246	<.01	<.3	<.01	<.005	na	211	616	na	na	0.05
Sep-00	**BPC2**	2.46	na	0.183	<.01	<.2	<.01	<.01	na	201	528	na	na	<DL
Oct-00	**BPC2**	2.82	na	0.274	<.01	<.2	<.01	<.01	na	238	648	na	na	<DL
Nov-00	**BPC2**	3.12	na	0.247	<.01	<.1	<.01	<.002	na	237	632	na	na	<DL
Dec-00	**BPC2**													
Jan-01	**BPC2**	3.3	na	0.334	<.01	<.1	<.01	<.01	na	260	1112	na	na	<DL
Feb-01	**BPC2**	2.27	na	0.124	<.01	<.1	<.01	<.01	na	158	856	na	na	0.1
Mar-01	**BPC2**	1.53	na	0.197	<.01	<.1	<.01	0.01	na	214	900	na	na	<DL
Apr-01	**BPC2**	1.14	na	0.105	<.01	<.1	<.01	<.005	na	95	916	na	na	0.05
May-01	**BPC2**	2.29	na	0.194	<.01	<.2	<.01	<.01	na	204	824	na	na	<DL
Jun-01	**BPC2**	3.01	na	0.191	<.01	<.2	<.01	<.01	na	215	784	na	na	0.03
Jul-01	**BPC2**	1.64	na	0.117	<.01	<.2	<.01	<.01	na	123	588	na	na	0.03
Aug-01	**BPC2**	2.73	na	0.168	<.01	<.1	<.01	<.01	na	185	592	na	na	<DL
Sep-01	**BPC2**	2.73	na	0.158	<.01	<.1	<.01	<.01	na	203	616	na	na	<DL
Oct-01	**BPC2**	2.31	na	0.11	<.01	<.2	<.01	0.003	na	153	484	na	na	<DL
Nov-01	**BPC2**													
Dec-01	**BPC2**	2.05	na	0.151	<.01	<.2	<.01	<.002	na	207	620	na	na	<DL
Jan-02	**BPC2**													
Feb-02	**BPC2**	2.45	na	0.233	<.01	<.2	<.01	<.001	na	233	912	na	na	0.01
Mar-02	**BPC2**	2.22	na	0.17	<.01	<.2	<.01	0.018	na	201	1012	na	na	0.03
Apr-02	**BPC2**	0.76	na	0.1	<.01	<.2	<.01	<.001	na	149	644	na	na	<DL
May-02	**BPC2**	0.84	na	0.055	<.01	<.2	<.01	0.013	na	110	360	na	na	0.05
Jun-02	**BPC2**	0.93	na	0.068	<.01	<.2	<.01	<.002	na	134	396	na	na	<DL
Jul-02	**BPC2**	1.65	na	0.117	<.01	<.2	<.01	<.002	na	193	420	na	na	<DL
Aug-02	**BPC2**	2.51	na	0.129	<.01	<.2	<.01	<.002	na	175	448	na	na	<DL
Sep-02	**BPC2**	1.31	na	0.113	<.01	<.1	<.01	<.002	na	263	588	na	na	<DL
	samples analyzed	89	na	89	89	89	89	89	na	89	89	na	na	89
	detects	89	na	89	3	1	3	37	na	89	89	na	na	59
	% detects	100	na	100	3	1	3	42	na	100	100	na	na	66
	min	0.76	na	0.01	0.01	0.6	0.01	0.002	na	78	324	na	na	0.01
	max	6.59	na	0.373	0.01	0.6	0.01	0.39	na	330	1508	na	na	0.27
	mean	3.3	na	0.2	0.01	-	0.01	0.06	na	223	758	na	na	0.05

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	Hg* mg/L	La* mg/L	Sc* mg/L	Zr* mg/L	IDC* mg/L	DOC* mg/L	TDC* mg/L	Hardness* mg/L	NO2-N* mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC2**	na	294	1.66	94.5	<DL	<2	<3	NA	54.7	119	173	497	<DL
Apr-94	**BPC2**	na	230	0.7	111	<.05	<.002	<.003	<.01	64.8	112	177	515	<.01
May-94	**BPC2**	na	226	0.51	126	<0.05	<2	<.3	<.01	58.2	116	174	530	<0.01
Jun-94	**BPC2**	na	118	1.72	42.3	<0.05	<2	<.3	<.01	10.7	48	58.6	102	<0.01
Jul-94	**BPC2**	na	148	0.45	128	<DL	<.005	<.005	<.01	6.8	11.3	18.1	497	<DL
Aug-94	**BPC2**	na	134	0.28	137	<DL	<.002	<.003	<.01	79.7	16	95.7	537	<DL
Sep-94	**BPC2**	na	122	0.33	133	<DL	<.002	<.003	NA	79.5	28.9	108	527	<DL
Oct-94	**BPC2**	na	105	2.9	53.3	<DL	<.002	<.003	NA	35.2	25.5	60.7	226	<DL
Nov-94	**BPC2**	na	159	3.34	92.2	<DL	<.002	<.003	<.01	64.5	11.4	75.9	371	<DL
Dec-94	**BPC2**													
Jan-95	**BPC2**	na	336	3.1	101	<DL	<.002	<.003	<.01	65.2	33.3	98.5	468	<DL
Feb-95	**BPC2**	na	232	1.68	98.1	<DL	<.005	<.005	<.01	64.9	0.5	65.4	474	<DL
Mar-95	**BPC2**	na	320	1.61	81.5	0.05	<.002	<.003	<.02	50.5	24.4	74.9	430	<DL
Apr-95	**BPC2**	na	198	1.8	90.8	<DL	<.002	<.003	<.02	59.8	9.6	69.4	396	<DL
May-95	**BPC2**	na	140	2.26	80.9	<DL	<.003	<.003	<.01	70.3	62.6	132.9	396	<DL
Jun-95	**BPC2**													
Jul-95	**BPC2**													
Aug-95	**BPC2**													
Sep-95	**BPC2**													
Oct-95	**BPC2**													
Nov-95	**BPC2**	na	281	2.79	138	<DL	<2	<3	<.01	53.7	30.5	84.2	487	<DL
Dec-95	**BPC2**	na	295	1.73	139	<DL	<.002	<.003	<.01	60.2	34.8	95	578	<DL
Jan-96	**BPC2**	na	310	2.31	136	<DL	<.002	<.003	<.01	55.3	37.4	92.7	544	<DL
Feb-96	**BPC2**	na	307	1.84	122	<DL	<.002	<.003	<.01	59.3	29.3	88.6	542	<DL
Mar-96	**BPC2**	na	438	1.37	115	<DL	<.002	<.003	<.01	47.7	43.8	91.5	498	<DL
Apr-96	**BPC2**	na	444	1.38	86.3	0.22	<.002	<.003	<.01	36.8	39	75.8	398	<DL
May-96	**BPC2**	na	265	2.48	89.2	<DL	<.002	<.003	<.01	37.1	39.3	76.4	391	<DL
Jun-96	**BPC2**	na	170	3.84	88	<DL	<.002	<.003	<.01	54	32.6	86.6	454	<DL
Jul-96	**BPC2**	na	125	3.48	66.1	<DL	<.002	<.003	<.01	41.2	35.2	76.4	363	<DL
Aug-96	**BPC2**	na	129	1.01	102	<DL	<.002	<.007	<.01	56	48.9	105	530	<DL
Sep-96	**BPC2**	na	48.1	0.61	54.2	<DL	<.002	<.003	<.01	25.1	13.4	38.5	196	<DL
Oct-96	**BPC2**	na	115	0.66	78	<DL	<.002	<.003	<.01	42.7	12.9	55.6	303	<DL
Nov-96	**BPC2**	na	199	1.33	109	0.06	<.002	<.003	<.01	54.6	22.8	77.4	447	<DL
Dec-96	**BPC2**	na	195	2.16	57.9	<DL	<.002	<.003	<.01	29.2	17.3	46.5	256	<DL
Jan-97	**BPC2**	na	389	5.66	78.3	<DL	<.002	<.003	<.01	45.1	21	66.1	468	0.01
Feb-97	**BPC2**	na	228	3.28	60.1	0.15	<.002	<.003	<.01	40.6	16.2	56.9	327	<DL
Mar-97	**BPC2**	na	209	2.03	88.1	<DL	<.002	<.003		52.6	14.4	67	438	<DL
Apr-97	**BPC2**	na	224	1.34	102	0.07	<.005	<.003		57.9	26.6	84.6	472	<DL
May-97	**BPC2**	na	183	0.85	97	0.08	<.005	<.003		51.9	31.8	83.7	482	<DL
Jun-97	**BPC2**	na	207	0.68	99.8	<DL	<.002	<.003		63.7	23.7	87.4	459	<DL
Jul-97	**BPC2**	na	143	0.55	112	<DL	<.002	<.003		62.9	36.2	99.1	485	<DL
Aug-97	**BPC2**	na	95.67	1.81	64.1	<DL	<.002	<.003		38.7	3.2	42	283	<DL
Sep-97	**BPC2**	na	153	0.43	114	<DL	<.002	<.003		57.9	26.1	84	451	<DL
Oct-97	**BPC2**	na	141	0.42	125	<DL	<.002	<.003		56.3	20.9	77.2	409	<DL
Nov-97	**BPC2**	na	140	0.22	126	<DL	<.002	<.003		57.7	20	77.8	484	<DL
Dec-97	**BPC2**	na	268.98	0.73	102	<DL	<.002	<.003		46	29.8	75.8	460	<DL
Jan-98	**BPC2**	na	388.76	2.28	88.2	<DL	<.002	<.003		37.5	20.9	58.3	411	<DL
Feb-98	**BPC2**	na	255.64	1.91	90.3	<DL	<.002	<.003		39.5	2.3	41.8	391	<DL
Mar-98	**BPC2**	na	216	1.58	80.8	0.06	<.002	<.003		34.3	9.1	43.4	365	<DL
Apr-98	**BPC2**	na	148	0.86	63.5	<DL	<.002	<.003		30.3	5.2	35.5	284	<DL
May-98	**BPC2**	na	155	0.95	83.4	0.58	<.002	<.003		47.6	34.9	82.5	388	<DL
Jun-98	**BPC2**	na	134	1.28	88.3	<DL	<.002	<.003		43.9	29.5	73.3	388	<DL
Jul-98	**BPC2**	na	106.065	0.55	72.1	<DL	<.002	<.003		36.6	24.1	60.7	322	<DL
Aug-98	**BPC2**	na	57.235	0.17	51.7	<DL	<.002	<.003		26.1	30.2	56.3	229	<DL
Sep-98	**BPC2**	na	59.325	0.32	48.1	<DL	<.002	<.003		21.6	22.1	43.7	193	<DL
Oct-98	**BPC2**	na	89.715	0.74	63.4	<DL	<.002	<.003		28.8	38.9	67.7	286	<DL
Nov-98	**BPC2**	na	121	0.74	83.5	0.21	<.002	<.003		38.8	64.1	102.9	401	<DL
Dec-98	**BPC2**													
Jan-99	**BPC2**	na	497	1.07	93.6	<DL	<.002	<.003		35.3	16.3	51.6	479	<DL
Feb-99	**BPC2**	na	218	0.94	106	<DL	<.002	<.003		62.4	11.6	74	431	<DL
Mar-99	**BPC2**	na	292	1.1	98.9	<DL	<.002	<.003		57.8	12	69.8	465	<DL
Apr-99	**BPC2**													
May-99	**BPC2**													
Jun-99	**BPC2**													
Jul-99	**BPC2**	na	105	0.3	95	<DL	<.002	<.003		68.9	17.4	86.2	446	<DL
Aug-99	**BPC2**	na	90	0.19	107	<DL	<.002	<.003		72.3	16.8	89.2	486	<DL
Sep-99	**BPC2**	na	72	0.4	55.7	<DL	<.002	<.003		26.1	22.9	49	204	<DL
Oct-99	**BPC2**	na	92	0.06	111	<DL	<.002	<.003		59.8	25.7	85.5	470	<DL
Nov-99	**BPC2**													
Dec-99	**BPC2**	na	104	0.14	97.1	<DL	<.002	<.003		75.1	20.3	95.4	478	<DL
Jan-00	**BPC2**	na	282	0.33	117	<DL	<.002	<.003		48.6	15.4	64	413	<DL
Feb-00	**BPC2**	na	758	0.87	96.2	<DL	<.002	<.003		37.4	20.8	58.2	460	<DL
Mar-00	**BPC2**	na	489	0.1	115	<DL	<.002	<.003		45.6	24.7	70.3	528	<DL
Apr-00	**BPC2**	na	207	1.63	77.6	<DL	<.002	<.003		35.7	19.9	55.6	334	<DL
May-00	**BPC2**	na	146	1.94	64.5	<DL	<.002	<.003		39.1	20.1	59.2	314	<DL
Jun-00	**BPC2**	na	112	1.43	52.1	<DL	<.002	<.003		36.3	19.4	55.7	264	<DL
Jul-00	**BPC2**	na	125	0.29	90	<DL	<.002	<.003		54.2	21.4	75.6	402	<DL
Aug-00	**BPC2**	na	132	0.16	86.6	<DL	<.002	<.003		45.8	20.2	65.9	348	<DL
Sep-00	**BPC2**	na	132	0.36	118	<DL	<.002	<.003		43.6	20.4	64	305	<DL
Oct-00	**BPC2**	na	163	0.06	91	<DL	<.002	<.003		52.5	19.9	72.4	408	<DL
Nov-00	**BPC2**	na	135	0.86	95.1	<DL	<.002	<.003		59.5	11.3	70.8	432	<DL
Dec-00	**BPC2**													
Jan-01	**BPC2**	na	377	0.43	116	<DL	<.002	<.003		66.5	9.2	75.8	531	<DL
Feb-01	**BPC2**	na	348	1.55	64.2	<DL	<.002	<.003		36.5	14.1	50.6	316	<DL
Mar-01	**BPC2**	na	326	1.01	94.9	<DL	<.002	<.003		55.5	16.1	71.7	476	<DL
Apr-01	**BPC2**	na	276	0.63	76.8	<DL		<.003		29.3	16.8	46.2	257	<DL
May-01	**BPC2**	na	273	0.73	81.6	0.18		<.003		52	28.8	80.8	403	<DL
Jun-01	**BPC2**	na	223	0.31	82.6	0.16		<.003		52.4	29.3	81.7	399	<DL
Jul-01	**BPC2**	na	194	0.18	54.9	0.07		<.003		31.3	5.7	37	239	<DL
Aug-01	**BPC2**	na	165	0.19	68.1	0.11		<.003		44.7	4.5	49.2	323	<DL
Sep-01	**BPC2**	na	139	0.15	61.8	<DL		<.003		46.6	4.8	51.3	328	<DL
Oct-01	**BPC2**	na	122	0.65	55.3	<DL		<.003		38	5.6	43.6	269	<DL
Nov-01	**BPC2**													
Dec-01	**BPC2**	na	155	0.41	71.7	<DL		<.003		50.4	0.4	50.8	350	<DL
Jan-02	**BPC2**													
Feb-02	**BPC2**	na	323	0.33	88.5	<DL		<.003		56	4.2	60.2	474	<DL
Mar-02	**BPC2**	na	389	1.24	88.2	0.06		<.003		46.2	4.9	51	413	<DL
Apr-02	**BPC2**	na	236	0.81	53.3	<DL		<.003		25.5	0.2	25.7	232	<DL
May-02	**BPC2**	na	141	0.3	27.6	<DL		<.003		16.6	2.6	19.2	122	<DL
Jun-02	**BPC2**	na	139	0.49	45.7	<DL		<.003		23	3.8	26.8	178	<DL
Jul-02	**BPC2**	na	123	0.22	50.6	<DL		<.003		31.4	1.9	33.3	226	<DL
Aug-02	**BPC2**	na	95	0.3	55.2	<DL		<.003		38.2	7.4	45.6	271	<DL
Sep-02	**BPC2**	na	115	0.2	82.9	<DL		<.003		62.5	7.9	70.3	212	<DL
	samples analyzed	na	89	89	89	89	73	89	27	89	89	89	89	89
	detects	na	89	89	89	14	0	0	0	89	89	89	89	1
	% detects	na	100	100	100	16	0	0	0	100	100	100	100	1
	min	na	48.1	0.06	27.6	0.05	-	-	-	6.8	0.2	18.1	102	0.01
	max	na	758	5.66	139	0.58	-	-	-	79.7	119	177	578	0.01
	mean	na	208	1	88	0.1	-	-	-	47	24	71	388	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC3**	7.78	1690		10		0.07	<.1	0.08	0.07	<1	107	<.01	<.01	<.01
Apr-94	**BPC3**	7.81	2559	10.2	12		0.08	<.1	0.12	0.08	<.001	98.6	<.01	<.01	<.01
May-94	**BPC3**	8.41	1615	25.0	3		0.14	<.1	0.12	0.05	<1	82.6	<.01	<.01	<.01
Jun-94	**BPC3**	7.84	448	20.5	>200		0.12	<.1	<.01	<DL	<1	25.6	<.01	<.01	<.01
Jul-94	**BPC3**	8.01	1241	20.9	5		0.06	<.1	0.1	0.07	<.001	81.4	<.02	<.02	<.01
Aug-94	**BPC3**	8.16	1271	24.0	3		0.07	<.1	0.12	0.08	<.001	81.2	<.01	<.01	<.01
Sep-94	**BPC3**	8.19	1471	17.9	4		<.02	<.1	0.1	0.07	<.001	85.3	<.01	<.01	<.01
Oct-94	**BPC3**	7.74	863	7.7	38		0.1	<.1	<.02	<DL	<.001	45.1	<.01	<.01	<.01
Nov-94	**BPC3**	8.14	2112	2.9	30		0.03	<.1	0.08	0.05	<.001	78.4	<.01	<.01	<.01
Dec-94	**BPC3**														
Jan-95	**BPC3**	7.97	3232	0.6	5		<.03	<.1	0.05	0.09	<.001	97.5	<.01	<.01	<.01
Feb-95	**BPC3**	8.12	2689	6.0	3		0.03	<.1	0.06	0.07	<.002	108	<.01	<.01	<.01
Mar-95	**BPC3**	7.90	2124	6.0	27		0.02	<.1	<.02	0.04	<.001	58.6	<.01	<.01	<.01
Apr-95	**BPC3**	8.38	1708	14.9	14		<.02	<.1	0.08	0.06	<.001	93.9	<.01	<.01	<.01
May-95	**BPC3**	8.28	1260	25.0	6		<.02	<.1	0.09	0.06	<.001	91.4	<.01	<.01	<.01
Jun-95	**BPC3**														
Jul-95	**BPC3**														
Aug-95	**BPC3**														
Sep-95	**BPC3**														
Oct-95	**BPC3**														
Nov-95	**BPC3**	7.91	2870	0.8	7		<.02	<.1	0.09	0.07	<1	99.4	<.01	<.01	<.01
Dec-95	**BPC3**	8.07	3463	0.3	10		<.01	<.1	0.1	0.09	0.002	136	<.01	<.01	<.01
Jan-96	**BPC3**	8.07	4068	0.0	25		0.05	<.1	0.08	0.07	<.002	120	<.01	<.01	<.01
Feb-96	**BPC3**	8.07	4390	0.3	6		0.06	<.1	0.08	0.08	<.002	122	<.01	<.01	<.01
Mar-96	**BPC3**	8.22	4299	9.0	18		0.08	<.1	0.04	0.08	<.001	111	<.01	<.01	<.01
Apr-96	**BPC3**	8.21	2273	13.5	10		0.05	<.1	0.05	0.07	<.001	80.4	<.01	<.01	<.01
May-96	**BPC3**	8.27	1860	23.1	4		0.04	<.1	0.12	0.07	<.001	81	<.01	<.01	<.01
Jun-96	**BPC3**	8.47	1790	25.3	5		<.02	<.1	0.12	0.08	<.001	106	<.01	<.01	<.01
Jul-96	**BPC3**	7.89	1360	22.5	53		<.02	<.1	0.1	0.06	<.001	84.4	<.01	<.01	<.01
Aug-96	**BPC3**	8.43	1210	25.3	2		<.01	<.1	0.1	0.06	<.001	75.2	<.01	<.01	<.01
Sep-96	**BPC3**	7.85	574	17.2	25		<.03	<.1	0.06	0.04	<.001	45.2	<.01	<.01	<.01
Oct-96	**BPC3**	7.81	591	11.5	27		<.03	<.1	0.08	0.04	<.001	57.4	<.01	<.01	<.01
Nov-96	**BPC3**	7.88	815	3.3	157		0.02	<.1	0.11	0.07	<.001	105	<.01	<.01	<.01
Dec-96	**BPC3**	7.45	711	1.7	168		0.06	<.1	0.04	0.04	<.001	62.8	<.01	<.01	<.01
Jan-97	**BPC3**	7.99	1515				0.05	<.1	0.06	0.08	<.001	109	<.01	<.01	<.01
Feb-97	**BPC3**	7.97	551	2.8	158		0.07	<.2	0.05	0.05	<.001	67.5	<.01	<.01	<.01
Mar-97	**BPC3**	8.92	1265	12.2	7		<.02	<.1	0.1	0.07	<DL	102	<.01	<.01	<.01
Apr-97	**BPC3**	8.33	1347	15.1	4		0.04	<.1	0.08	0.08	<.001	102	<.01	<.01	<.01
May-97	**BPC3**	8.34	1125	14.4	16		<.04	<.2	0.12	0.08	<.002	101	<.01	<.01	<.01
Jun-97	**BPC3**	8.00	1170	18.4	39		<.02	<.1	0.09	0.07	<.002	84.4	<.01	<.01	<.01
Jul-97	**BPC3**	8.18	1370	24.9	8		<.02	<.1	0.09	0.08	<.001	98.9	<.01	<.01	<.01
Aug-97	**BPC3**	8.02	835	18.6	76		0.07	<.1	0.07	0.06	<.001	79.6	<.01	<.01	<.01
Sep-97	**BPC3**	8.08	963	14.6	10		0.05	<.2	0.12	0.08	<.001	90	<.01	<.01	<.01
Oct-97	**BPC3**	8.21	845	11.3	26		<.02	<.2	0.07	0.07	<DL	89.4	<.01	<.01	<.01
Nov-97	**BPC3**	8.06	1620	3.5	6		<.02	<.3	0.07	0.07	<.002	90.9	<.01	<.01	<.01
Dec-97	**BPC3**	8.03	1311	2.1	25		<.02	<.3	0.08	0.06	<.002	94	<.01	<.01	0.02
Jan-98	**BPC3**	8.13	1669	3.1	611		0.03	<.1	0.09	0.12	<.001	113	<.01	<.01	<.01
Feb-98	**BPC3**	8.55	1276	9.3	62		0.03	<.2	0.06	0.05	<.001	81.5	<.01	<.01	<.01
Mar-98	**BPC3**	8.39	1355	12.7	48		0.02	<.1	0.05	0.05	<.001	84.3	<.01	<.01	<.01
Apr-98	**BPC3**	8.19	870	15.8	93		0.03	<.1	0.05	0.04	<.001	65.2	<.01	<.01	<.01
May-98	**BPC3**	8.21	1090	19.1	12		<.02	<.1	0.07	0.06	<.001	82.2	<.01	<.01	<.01
Jun-98	**BPC3**	7.84	984	26.7	16		<.02	<.1	0.1	0.07	<.001	81.6	<.01	<.01	<.01
Jul-98	**BPC3**	8.24	612	23.8	28		<.02	<.1	0.06	0.05	<.001	58.3	<.02	<.01	<.01
Aug-98	**BPC3**	8.58	718	27.8	39		<.02	<.1	0.08	0.04	<.001	47.1	<.02	<.01	<.01
Sep-98	**BPC3**	8.25	618	22.3	16		0.04	<.1	0.09	0.04	<.003	49.7	<.01	<.01	<.01
Oct-98	**BPC3**	8.43	874	16.0	16		0.03	<.1	0.07	0.06	<.001	73.8	<.01	<.01	<.01
Nov-98	**BPC3**	8.25	1003	7.1	14		0.03	<.1	0.1	0.06	<.001	88	<.01	<.01	<.01
Dec-98	**BPC3**														
Jan-99	**BPC3**	7.61	2780	2.4	31		<.01	<.1	0.07	0.11	<.001	119	<.01	<.01	<.01
Feb-99	**BPC3**	7.71	1904	5.4	40		0.03	<.1	0.06	0.08	<.002	99.8	<.01	<.01	<.01
Mar-99	**BPC3**	8.71	1642	10.2	7		<.01	<.1	0.06	0.08	<.002	98.8	<.01	<.01	<.01
Apr-99	**BPC3**														
May-99	**BPC3**														
Jun-99	**BPC3**														
Jul-99	**BPC3**	8.35	1076	27.7	8		<.02	<.1	0.09	0.07	<.001	74.1	<.01	<.01	<.01
Aug-99	**BPC3**	8.06	940	27.5	8		<.02	<.1	0.08	0.05	<.003	68.6	<.01	<.01	<.01
Sep-99	**BPC3**	7.60	536	16.0	54		0.06	<.1	0.05	<DL	<.001	42.1	<.01	<.01	<.01
Oct-99	**BPC3**	8.00		8.9			0.02	<.1	0.11	0.07	<.002	92.8	<.01	<.01	<.01
Nov-99	**BPC3**														
Dec-99	**BPC3**	8.20	1054	6.5	0		<.02	<.2	0.09	0.06	<.001	74.4	<.01	<.01	<.01
Jan-00	**BPC3**	8.03	1759	1.8	51		<.02	<.2	0.06	0.06	<.001	82.6	<.01	<.01	<.01
Feb-00	**BPC3**	7.76	3534	4.2	94		<.01	<.2	0.07	0.098	<.001	114	<.01	<.01	<.01
Mar-00	**BPC3**	8.25	2527	6.9	8		<.01	<.1	0.06	0.093	<.001	112	<.02	<.01	<.01
Apr-00	**BPC3**	8.10	1182	12.5	50		<.02	<.1	0.06	0.045	<.001	68.6	<.01	<.01	<.01
May-00	**BPC3**	8.12	968	17.5	69		<DL	<.1	0.06	0.059	<.001	69.6	<.01	<.01	<.01
Jun-00	**BPC3**	8.11	766	23.4	129		<.01	<.1	0.07	0.052	<.001	54.2	<.01	<.01	<.01
Jul-00	**BPC3**	8.20	1262	22.7	14		<.01	<.1	0.08	0.073	<.001	79.1	<.01	<.01	<.01
Aug-00	**BPC3**	8.20	1028	22.2	14		<.01	<.2	0.101	0.069	<.001	64.6	<.01	<.01	<.01
Sep-00	**BPC3**	8.01	1171	15.9	48		<.1	<.2	0.1	0.029	<.001	51.5	<.01	<.01	<.01
Oct-00	**BPC3**	7.73	1106	15.4	56		<.1	<.2	0.1	0.069	<.001	78.4	<.01	<.01	<.01
Nov-00	**BPC3**	7.33	1465	0.7	330		<.02	<.05	0.095	0.077	<.001	109	<.01	<.01	<.01
Dec-00	**BPC3**														
Jan-01	**BPC3**														
Feb-01	**BPC3**	7.25	1630	2.1	81		<.3	<.1	0.03	0.047	<.001	71.3	<.01	<.01	<.01
Mar-01	**BPC3**	7.77	1792	6.7	21		<.3	<.1	0.07	0.065	<.001	105	<.01	<.01	<.01
Apr-01	**BPC3**	8.14	1743	16.7	29		<.02	<.1	0.06	0.028	<.001	55.9	<.01	<.01	<.01
May-01	**BPC3**	7.72	1591	13.9	21		<.01	<.1	0.1	0.064	<.001	84.6	<.01	<.01	<.01
Jun-01	**BPC3**	7.71	1521	18.5	29		<DL	<.1	0.06	0.066	<.001	81.9	<.01	<.01	<.01
Jul-01	**BPC3**	7.93	492	22.3	6		<DL	<.1	0.05	0.026	<.001	42.9	<.01	<.01	<.01
Aug-01	**BPC3**	7.19	991	20.8	9		<DL	<.2	0.07	0.05	<.001	57.5	<.01	<.01	<.01
Sep-01	**BPC3**														
Oct-01	**BPC3**	7.84	918	8.9	32		<.02	<.2	0.08	0.042	<.003	64	<.01	<.01	<.04
Nov-01	**BPC3**														
Dec-01	**BPC3**	8.14	1082	2.1	16		<.02	<.2	0.08	0.054	<.003	80.9	<.01	<.01	<.04
Jan-02	**BPC3**														
Feb-02	**BPC3**	7.15	2051	2.1	7		<.02	<.1	0.09	0.083	<.001	110	<.01	<.01	<.01
Mar-02	**BPC3**	7.42	1890	5.7	40		<.02	<.1	0.07	0.06	0.008	99.2	<.01	0.02	0.01
Apr-02	**BPC3**	8.12	1636	11.7	43		<.1	<.1	0.06	0.029	<.001	43.6	<.01	<.01	<.01
May-02	**BPC3**	6.93	1318	15.1	66		<.1	<.1	0.05	0.023	<.001	29.2	<.01	<.01	<.01
Jun-02	**BPC3**	7.52	663	20.3	139		<.02	<.1	0.03	0.025	<.002	29.4	<.01	<.01	<.01
Jul-02	**BPC3**	8.28	1015	31.2	42		<.02	<.1	0.02	0.032	<.002	44	<.01	<.01	<.01
Aug-02	**BPC3**	7.56	810	24.1	61		<.02	<.1	0.04	0.042	<.002	49	<.01	<.01	<.01
Sep-02	**BPC3**	7.24	911	19.1	21		<.01	<.1	0.07	0.033	<.001	31.1	<.01	<.01	<.01
	samples analyzed						87	87	87	87	87	87	87	87	87
	detects						32	0	84	84	2	87	0	1	2
	% detects						37	0	97	97	2	100	0	1	2
	min	6.93	448	0.0	0		0.02	-	0.02	0.023	0.002	25.6	-	0.02	0.01
	max	8.92	4390	31.2	611		0.14	-	0.12	0.12	0.008	136	-	0.02	0.02
	mean	8.01	1492	13	44		0.1	-	0.08	0.06	0.005	80.3	-	-	0.02

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	Ni mg/L	P mg/L	Pb mg/L	S mg/L	Sb mg/L	Se mg/L
		0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC3**	<.01	0.13	2	0.01	53.3	0.14	<.01	171	<.03	0.01	<.08	na	<.1	<.1
Apr-94	**BPC3**	<.01	0.38	4	0.01	60.1	0.22	<.01	193	<.03	<.01	<.08	na	<.1	<.1
May-94	**BPC3**	<.01	0.48	2	<.01	60.1	0.16	<.01	177	<.03	0.06	<.08	na	<.1	<.1
Jun-94	**BPC3**	<.01	0.08	1	<.01	12.7	0.07	<.01	47.5	<.03	0.07	<.08	na	<.1	<.1
Jul-94	**BPC3**	<.01	0.15	3	<.01	50.2	0.08	<.02	96.9	<.04	0.04	<.04	na	<.2	<.2
Aug-94	**BPC3**	<.01	0.21	3	0.01	51.1	0.06	<.02	127	<.03	0.17	<.08	na	<.1	<.1
Sep-94	**BPC3**	<.01	<DL	3	0.01	45.3	0.06	<.02	118	<.03	0.08	<.05	na	<.1	<.2
Oct-94	**BPC3**	<.01	0.15	3	<.01	19.8	0.01	<.02	52.8	<.03	0.17	<.05	na	<.2	<.2
Nov-94	**BPC3**	<.01	<.01	2	<.01	36.5	0.02	<.02	76.1	<.03	0.09	<.06	na	<.1	<.2
Dec-94	**BPC3**														
Jan-95	**BPC3**	<.01	<DL	4	<.01	39.6	0.1	<.02	638	<.03	0.21	<.05	na	<.3	<.1
Feb-95	**BPC3**	<.01	<.01	2	0.01	52.9	0.1	<.02	172	<.02	0.02	<.04	na	<.1	<.1
Mar-95	**BPC3**	<.01	<.01	<1	<.01	26.0	0.05	<.02	151	<.03	0.05	<.05	na	<.2	<.1
Apr-95	**BPC3**	<.01	<.01	<1	<.01	46.7	0.08	<.02	112	<DL	0.01	<.05	na	<.2	<.1
May-95	**BPC3**	<.01	<.01	2	<.01	44.7	<.01	<.02	99.1	<.03	0.01	<.08	na	<.1	<.1
Jun-95	**BPC3**														
Jul-95	**BPC3**														
Aug-95	**BPC3**														
Sep-95	**BPC3**														
Oct-95	**BPC3**														
Nov-95	**BPC3**	<.01	<DL	<1	<.01	46.6	0.07	<.02	147	<.03	0.03	<.05	na	<.2	<.2
Dec-95	**BPC3**	<.01	<DL	3	0.01	64.4	0.11	<.02	190	<.03	0.04	<.05	na	<.2	<.1
Jan-96	**BPC3**	<.01	<.01	2	0.01	54.6	0.1	<.02	169	<.03	0.03	<.05	na	<.2	<.1
Feb-96	**BPC3**	<.01	0.16	4	0.01	56.5	0.11	<.02	193	<.03	0.04	<.08	na	<.1	<.1
Mar-96	**BPC3**	<.01	0.17	3	0.01	54.0	0.09	<.02	277	<.03	0.03	<.04	na	<.1	<.1
Apr-96	**BPC3**	<DL	<.01	2	<.01	37.6	0.02	<.02	221	<.03	0.08	<.05	na	<.1	<.2
May-96	**BPC3**	<DL	<DL	4	<.01	41.0	0.01	<.02	140	<.03	0.04	<.05	na	<.2	<.1
Jun-96	**BPC3**	0.05	<.01	2	<.01	49.4	0.02	<.02	128	<.03	0.05	<.05	na	<.2	<.2
Jul-96	**BPC3**	<DL	<.01	3	<.01	36.7	0.03	<.02	93.7	<.03	0.02	<.04	na	<.2	<.2
Aug-96	**BPC3**	0.1	<.01	3	<.03	40.5	0.03	<.02	80.3	<.03	0.04	<.05	na	<.2	<.2
Sep-96	**BPC3**	<.01	<.01	6	<.01	24.2	0.03	<.02	48.5	<.03	0.13	<.05	na	<.2	<.2
Oct-96	**BPC3**	0.03	<.01	<1	<.01	29.0	0.02	<.02	71.7	<.03	0.07	<.05	na	<.2	<.2
Nov-96	**BPC3**	<DL	<.01	3	<.01	48.9	0.09	<.02	134	<.03	0.03	<.04	na	<.2	<.2
Dec-96	**BPC3**	<DL	<.03	3	<.01	25.7	0.01	<.02	143	<.03	0.14	<.05	na	<.2	<.2
Jan-97	**BPC3**	0.03	<.1	5	<.01	47.5	0.05	<.02	264	<.03	0.06	<.05	na	<.2	<.2
Feb-97	**BPC3**	0.07	<.03	3	<.01	30.0	<.01	<.02	119	<.03	0.1	<.05	na	<.2	<.2
Mar-97	**BPC3**	0.02	<.01	<1	<.01	52.5	<.01	<.02	187	<.03	0.02	<.05	na	<.2	<.2
Apr-97	**BPC3**	<.01	0.21	<1	0.01	54.7	0.04	<.01	181	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC3**	<.02	<DL	4	<.01	55.5	0.14	<.02	172	<.03	0.03	<.05	na	<.2	<.2
Jun-97	**BPC3**	<.02	<.01	<1	<.01	46.5	0.1	<.02	162	<.03	0.04	<.05	na	<.2	<.1
Jul-97	**BPC3**	<DL	<DL	3	0.01	49.9	0.02	<.01	142	<.03	0.03	<.05	na	<.2	<.2
Aug-97	**BPC3**	0.03	0.05	3	<.01	35.5	0.01	<.02	86.9	<.03	<DL	<.05	na	<.2	<.2
Sep-97	**BPC3**	<.01	0.05	5	<.01	41.4	0.01	<.02	123	<.03	0.01	<.05	na	<.2	<.1
Oct-97	**BPC3**	<.01	<.01	5	0.01	40.9	<.01	<.02	84	<.03	<DL	<.05	na	<.2	<.1
Nov-97	**BPC3**	<.02	<.01	3	<.01	41.8	0.05	<.02	182	<.03	0.09	<.05	na	<.2	<.2
Dec-97	**BPC3**	<.02	<.01	3	<.01	41.6	0.08	0.17	148	<.03	0.03	<.05	na	<.2	<.2
Jan-98	**BPC3**	<.01	<.01	5	0.01	50.7	0.29	<.02	282	<.03	0.02	<.05	na	<.1	<.2
Feb-98	**BPC3**	<.01	<.02	3	0.01	37.3	0.03	<.02	147	<.03	0.01	<.05	na	<.2	<.1
Mar-98	**BPC3**	<.01	<.01	3	0.01	38.6	0.01	<.01	131	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC3**	<.01	<.01	2	<.01	32.7	<.01	<.02	107	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC3**	<.01	<.01	2	<.01	39.6	0.04	<.02	106	<.03	0.02	<.05	na	<.1	<.2
Jun-98	**BPC3**	<.01	<.01	3	<.01	39.5	0.02	<.02	95.3	<.03	0.04	<.05	na	<.1	<.2
Jul-98	**BPC3**	<.03	<.01	<3	<.02	28.0	0.02	<.02	45.9	<.03	0.06	<.05	na	<.3	<.2
Aug-98	**BPC3**	<.03	<.01	<2	<.02	23.1	<.01	<.02	67.3	<.03	0.04	<.05	na	<.3	<.2
Sep-98	**BPC3**	<.01	<DL	4	<.01	21.9	<.01	0.13	47.1	<.03	0.05	<.07	na	<.2	<.1
Oct-98	**BPC3**	<.01	<DL	3	<.01	32.9	<.01	<.02	70.8	<.03	0.03	<.05	na	<.2	<.2
Nov-98	**BPC3**	<.01	<DL	4	<.01	39.4	0.03	<.02	90.2	<.03	0.04	<.05	na	<.2	<.2
Dec-98	**BPC3**														
Jan-99	**BPC3**	<.01	<.01	2	<.01	50.5	0.06	<.02	446	<.03	<DL	<.05	na	<.2	<.1
Feb-99	**BPC3**	<.01	<.01	4	<.01	47.1	0.03	<.02	257	<.03	<DL	<.03	na	<.2	<.2
Mar-99	**BPC3**	<.01	<.01	3	<.01	49.0	<.01	<.02	190	<.03	<DL	<.03	na	<.2	<.2
Apr-99	**BPC3**														
May-99	**BPC3**														
Jun-99	**BPC3**														
Jul-99	**BPC3**	<.01	<.01	3	<.01	42.6	<.01	<.02	114	<.03	0.07	<.05	na	<.1	<.1
Aug-99	**BPC3**	<.01	<DL	<1	0.02	42.8	0.01	<.02	86.5	<.02	0.01	<.05	na	<.2	<.2
Sep-99	**BPC3**	<.01	0.05	<1	<.05	20.5	<.01	<.02	44.2	<.03	0.16	<.05	na	<.3	<.2
Oct-99	**BPC3**	<.01	<.01	6	0.01	46.5	0.03	<.02	93.3	<.03	0.05	<.05	na	<.3	<.2
Nov-99	**BPC3**														
Dec-99	**BPC3**	<.01	<.01	3	<.01	36.6	0.02	<.02	96.9	<.03	0.19	<.05	na	<.1	<.2
Jan-00	**BPC3**	<.01	<.01	5	<.01	37.4	0.04	<.02	210	<.1	0.05	<.05	na	<.2	<.2
Feb-00	**BPC3**	<.01	<.01	7	0.01	46.2	0.005	<.02	550	<.01	0.07	<.02	na	<.05	<.05
Mar-00	**BPC3**	0.01	<.01	4	0.01	55.7	0.043	<.01	365	<.01	<DL	<.03	na	<.1	<.1
Apr-00	**BPC3**	<.01	0.02	4	<.01	36.9	0.011	<.01	135	<.01	<DL	<.02	na	<.1	<.1
May-00	**BPC3**	<.01	0.01	4	0.01	31.5	0.001	<.01	101	<.01	0.01	<.02	na	<.1	<.1
Jun-00	**BPC3**	0.006	0.05	3	<DL	24.2	0.006	<.01	78	<.01	<DL	<.03	na	<.1	<.1
Jul-00	**BPC3**	<.01	<.01	4	<.01	41.7	0.021	<.02	127	<.01	0.03	<.02	na	<.1	<.1
Aug-00	**BPC3**	0.003	0.01	4	0.01	36.0	0.015	<.03	101	<.01	<DL	<.03	na	<.1	<.1
Sep-00	**BPC3**	<.01	0.02	4	<.01	40.4	0.243	<.02	105	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC3**	<.01	0.01	3	<.01	38.6	<.001	<.02	95.6	<.01	<DL	<.03	na	<.2	<.2
Nov-00	**BPC3**	<.005	<.01	4	0.01	49.1	<.001	<.01	146	<.01	<DL	<.02	na	<.1	<.1
Dec-00	**BPC3**														
Jan-01	**BPC3**														
Feb-01	**BPC3**	<.003	<.01	5	<.01	30.5	<.001	<.02	225	<.01	0.04	<.05	na	<.1	<.1
Mar-01	**BPC3**	<.003	<.01	3	<.01	52.8	<.001	<.02	232	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC3**	<.01	<.01	6	<.01	34.6	0.006	<.02	192	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC3**	0.01	<.01	4	0.01	43.7	<.002	<.02	208	<.01	<DL	<.05	na	<.1	<.1
Jun-01	**BPC3**	0.01	<.01	4	0.01	40.1	<.002	<.02	190	<.01	<DL	<.05	na	<.1	<.1
Jul-01	**BPC3**	<.01	0.01	3	<.01	17.6	<.002	<.02	32.4	<.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC3**	<.01	<.01	3	<.01	28.9	<.004	<.01	106	<.01	<DL	<.05	na	<.1	<.1
Sep-01	**BPC3**														
Oct-01	**BPC3**	0.003	0.01	4	<.01	29.9	0.01	<.01	85.8	<.01	0.05	<.02	na	<.1	<.2
Nov-01	**BPC3**														
Dec-01	**BPC3**	<.003	<.01	<1	<.01	35.4	0.031	<.01	118	<.01	<DL	<.02	na	<.1	<.2
Jan-02	**BPC3**														
Feb-02	**BPC3**	0.011	<.01	<1	0.01	47.5	0.055	<.05	268	<.01	0.03	<.03	na	<.1	<.1
Mar-02	**BPC3**	0.012	<.01	<1	0.01	36.8	0.015	<.05	238	<.01	0.04	<.03	na	<.1	<.1
Apr-02	**BPC3**	0.01	<.01	4	<.01	24.9	0.015	<.01	172	0.01	0.08	<.02	na	<.1	<.1
May-02	**BPC3**	0.01	<.01	2	<.01	19.5	0.016	<.01	140	<.01	<DL	<.02	na	<.1	<.1
Jun-02	**BPC3**	<.01	<.01	3	<.01	14.2	0.011	<.01	72.2	<.01	0.03	<.05	na	<.1	<.1
Jul-02	**BPC3**	<.01	<.01	3	<.01	17.3	0.008	<.01	68	<.01	0.03	<.05	na	<.1	<.1
Aug-02	**BPC3**	<.01	<.01	4	<.01	22.9	0.012	<.01	81	<.01	0.03	<.05	na	<.1	<.1
Sep-02	**BPC3**	<.01	0.03	<1	<.01	15.1	0.017	<.01	67.1	<.01	<DL	<.05	na	<.1	<.1
	samples analyzed	87	87	87	87	87	87	87	87	87	87	87	na	87	87
	detects	17	22	72	26	87	68	2	87	1	64	0	na	0	0
	% detects	20	25	83	30	100	78	2	100	1	74	0	na	0	0
	min	0.003	0.01	1	0.01	12.7	0.001	0.13	32.4	0.01	0.01	-	-	-	-
	max	0.1	0.48	7	0.02	64.4	0.29	0.17	638	0.01	0.21	-	-	-	-
	mean	0.02	0.1	3	0.01	39.2	0.05	0.15	151	-	0.05	-	-	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC3**	3.18	na	0.17	<.01	<.1	0.01	<.01	na	264	1060	na	na	0.03
Apr-94	**BPC3**	2.21	na	0.18	<.01	<.3	<.01	<.01	na	242	1180	na	na	0.28
May-94	**BPC3**	1.57	na	0.23	<.01	<.3	<.01	<.01	na	179	952	na	na	0.02
Jun-94	**BPC3**	1.65	na	0.07	<.01	<.3	<.01	<.01	na	68	284	na	na	0.17
Jul-94	**BPC3**	3.51	na	0.27	<.01	<.2	<.01	<.02	na	199	800	na	na	0.09
Aug-94	**BPC3**	1.66	na	0.21	<.01	<.3	<.01	<.01	na	206	900	na	na	0.08
Sep-94	**BPC3**	3.12	na	0.2	<.01	<.3	<.01	<.01	na	223	832	na	na	0.09
Oct-94	**BPC3**	2.6	na	0.1	0.01	<.4	<.01	0.02	na	115	576	na	na	0.02
Nov-94	**BPC3**	3.6	na	0.13	<.01	<.3	<.01	<.01	na	248	836	na	na	0.04
Dec-94	**BPC3**													
Jan-95	**BPC3**	2.51	na	0.2	<.01	<.3	<.01	0.02	na	161	2244	na	na	0.38
Feb-95	**BPC3**	2.68	na	0.17	<.01	<.2	<.01	0.02	na	250	1000	na	na	0.08
Mar-95	**BPC3**	1.4	na	0.11	<.01	<.4	<.01	0.05	na	142	776	na	na	0.07
Apr-95	**BPC3**	2.17	na	0.15	<.01	<.4	<.01	0.11	na	243	848	na	na	0.03
May-95	**BPC3**	3.54	na	0.14	<.01	<.3	<.01	0.33	na	268	768	na	na	0.16
Jun-95	**BPC3**													
Jul-95	**BPC3**													
Aug-95	**BPC3**													
Sep-95	**BPC3**													
Oct-95	**BPC3**													
Nov-95	**BPC3**	3.5	na	0.17	<.01	<.4	<.01	0.02	na	236	964	na	na	0.05
Dec-95	**BPC3**	3.75	na	0.23	<.01	<.3	<.01	<.01	na	272	1196	na	na	0.09
Jan-96	**BPC3**	3.08	na	0.2	<.01	<.6	<.01	0.02	na	252	1172	na	na	0.15
Feb-96	**BPC3**	3.05	na	0.2	<.01	<.3	<.01	<.01	na	243	1192	na	na	0.1
Mar-96	**BPC3**	2.15	na	0.2	<.01	<.3	<.01	0.01	na	236	1464	na	na	0.07
Apr-96	**BPC3**	2.24	na	0.17	<.01	<.3	<.01	<.01	na	177	1124	na	na	0.01
May-96	**BPC3**	2.56	na	0.15	<.01	<1	0.01	0.02	na	207	844	na	na	0.04
Jun-96	**BPC3**	3.97	na	0.17	<.01	<.6	<.01	0.03	na	271	920	na	na	0.05
Jul-96	**BPC3**	4.33	na	0.13	0.01	<.2	<.01	0.05	na	231	736	na	na	0.18
Aug-96	**BPC3**	1.44	na	0.15	<.01	<.3	<.01	0.08	na	202	616	na	na	0.01
Sep-96	**BPC3**	2.11	na	0.12	<.01	<.3	<.01	0.04	na	144	444	na	na	0.09
Oct-96	**BPC3**	2.44	na	0.13	<.01	<.3	<.01	0.01	na	172	508	na	na	0.1
Nov-96	**BPC3**	3.62	na	0.18	<.01	<.3	<.01	<.01	na	267	980	na	na	0.29
Dec-96	**BPC3**	2.01	na	0.12	<.01	<.3	<.01	<.01	na	144	748	na	na	0.15
Jan-97	**BPC3**	3.57	na	0.19	<.01	<.3	<.01	0.01	na	207	1100	na	na	0.03
Feb-97	**BPC3**	3.26	na	0.11	<.01	<.3	<.01	0.05	na	153	664	na	na	0.09
Mar-97	**BPC3**	1.57	na	0.17	<.01	<.3	<.01	0.01	na	229	936	na	na	0.07
Apr-97	**BPC3**	0.86	na	0.18	<.01	<0	<.01	<.01	na	259	1020	na	na	0.04
May-97	**BPC3**	1.57	na	0.18	<.01	<.3	<.01	0.02	na	239	1064	na	na	0.12
Jun-97	**BPC3**	3.83	na	0.16	<.01	<.3	<.01	0.01	na	232	1028	na	na	0.18
Jul-97	**BPC3**	4.05	na	0.19	<.01	<.3	<.01	0.01	na	236	996	na	na	0.04
Aug-97	**BPC3**	3.88	na	0.13	<.01	<.3	<.01	<.01	na	176	612	na	na	<DL
Sep-97	**BPC3**	2.42	na	0.16	<.01	<.4	<.01	<.01	na	230	856	na	na	0.08
Oct-97	**BPC3**	2.63	na	0.17	<.01	<.4	<.01	<.01	na	200	840	na	na	0.06
Nov-97	**BPC3**	2.4	na	0.21	<.01	<.3	<.01	<.01	na	213	948	na	na	0.03
Dec-97	**BPC3**	2.59	na	0.2	<.01	<.3	<.01	<.01	na	202	844	na	na	0.12
Jan-98	**BPC3**	3.12	na	0.23	<.01	<.3	<.01	<.01	na	186	1068	na	na	<DL
Feb-98	**BPC3**	1.72	na	0.14	<.01	<.2	<.01	<.01	na	186	792	na	na	0.02
Mar-98	**BPC3**	2.4	na	0.13	<.01	<.2	<.01	<.01	na	197	736	na	na	0.09
Apr-98	**BPC3**	1.29	na	0.11	<.01	<.3	<.01	<.01	na	173	660	na	na	0.02
May-98	**BPC3**	2.8	na	0.14	<.01	<.3	<.01	<.01	na	232	808	na	na	0.14
Jun-98	**BPC3**	2.88	na	0.14	<.01	<.3	<.01	<.01	na	236	704	na	na	0.06
Jul-98	**BPC3**	1.59	na	0.11	<.01	<.3	<.01	<.01	na	169	464	na	na	0.02
Aug-98	**BPC3**	1.04	na	0.09	<.01	<.3	<.01	<.01	na	145	428	na	na	0.1
Sep-98	**BPC3**	2.44	na	0.09	<.01	<.3	<.01	<.01	na	142	380	na	na	0.06
Oct-98	**BPC3**	3.12	na	0.12	<.01	<.3	<.01	0.02	na	208	528	na	na	0.38
Nov-98	**BPC3**	3.15	na	0.14	<.01	<.3	<.01	<.01	na	244	648	na	na	0.09
Dec-98	**BPC3**													
Jan-99	**BPC3**	3.11	na	0.23	<.01	<.3	<.01	<.01	na	229	1620	na	na	0.24
Feb-99	**BPC3**	2.09	na	0.18	<.01	<.3	<.01	<.01	na	247	1160	na	na	0.13
Mar-99	**BPC3**	1.85	na	0.21	<.01	<.3	<.01	<.01	na	223	988	na	na	0.04
Apr-99	**BPC3**													
May-99	**BPC3**													
Jun-99	**BPC3**													
Jul-99	**BPC3**	1.22	na	0.15	<.01	<.2	<.01	<.01	na	210	784	na	na	0.06
Aug-99	**BPC3**	1.81	na	0.16	<.01	<.2	<.01	<.01	na	189	620	na	na	0.04
Sep-99	**BPC3**	1.93	na	0.11	<.01	<.3	<.01	<.01	na	171	380	na	na	0.11
Oct-99	**BPC3**	2.36	na	0.27	<.01	<.3	<.01	<.01	na	237	696	na	na	<DL
Nov-99	**BPC3**													
Dec-99	**BPC3**	1.98	na	0.19	<.01	<.5	<.01	0.04	na	197	608	na	na	0.04
Jan-00	**BPC3**	1.2	na	0.2	<.01	<.3	<.01	0.03	na	174	1008	na	na	<DL
Feb-00	**BPC3**	1.97	na	0.259	<.01	<.1	<.01	0.009	na	150	1936	na	na	<DL
Mar-00	**BPC3**	0.66	na	0.261	<.01	<.1	<.01	0.005	na	200	1412	na	na	<DL
Apr-00	**BPC3**	2.49	na	0.122	<.01	<.1	<.01	0.07	na	172	764	na	na	0.05
May-00	**BPC3**	2.11	na	0.12	<.01	<.1	<.01	0.002	na	173	596	na	na	0.03
Jun-00	**BPC3**	2.27	na	0.101	<.01	<.1	<.01	0.007	na	159	456	na	na	0.02
Jul-00	**BPC3**	1.5	na	0.154	<.01	<.1	<.01	<.01	na	205	720	na	na	<DL
Aug-00	**BPC3**	1.68	na	0.197	<.01	<.3	<.01	<.005	na	171	636	na	na	0.06
Sep-00	**BPC3**	1.35	na	0.127	<.01	<.2	<.01	<.01	na	167	676	na	na	<DL
Oct-00	**BPC3**	1.57	na	0.169	<.01	<.2	<.01	<.01	na	199	648	na	na	0.05
Nov-00	**BPC3**	2.86	na	0.173	<.01	<.1	<.01	<.002	na	249	880	na	na	0.06
Dec-00	**BPC3**													
Jan-01	**BPC3**													
Feb-01	**BPC3**	2.16	na	0.109	<.01	<.1	<.01	<.01	na	147	900	na	na	0.11
Mar-01	**BPC3**	1.76	na	0.168	<.01	<.1	<.01	<.01	na	234	992	na	na	0.01
Apr-01	**BPC3**	1.29	na	0.108	<.01	<.1	<.01	<.005	na	117	1076	na	na	0.1
May-01	**BPC3**	1.1	na	0.165	<.01	<.2	<.01	<.01	na	187	932	na	na	<DL
Jun-01	**BPC3**	1.27	na	0.155	<.01	<.2	<.01	<.01	na	184	908	na	na	0.04
Jul-01	**BPC3**	2.96	na	0.088	<.01	<.2	<.01	<.01	na	91	320	na	na	0.03
Aug-01	**BPC3**	0.9	na	0.126	<.01	<.1	<.01	<.01	na	146	584	na	na	<DL
Sep-01	**BPC3**													
Oct-01	**BPC3**	2.66	na	0.104	<.01	<.2	<.01	0.007	na	172	540	na	na	<DL
Nov-01	**BPC3**													
Dec-01	**BPC3**	1.76	na	0.137	<.01	<.2	<.01	<.002	na	206	684	na	na	0.02
Jan-02	**BPC3**													
Feb-02	**BPC3**	1.78	na	0.212	<.01	<.2	<.01	0.005	na	232	1148	na	na	0.04
Mar-02	**BPC3**	2.08	na	0.157	<.01	<.2	<.01	0.025	na	201	1036	na	na	0.04
Apr-02	**BPC3**	1.02	na	0.088	<.01	<.2	<.01	<.001	na	135	668	na	na	<DL
May-02	**BPC3**	0.61	na	0.066	<.01	<.2	<.01	0.007	na	121	512	na	na	0.08
Jun-02	**BPC3**	1.18	na	0.06	<.01	<.2	<.01	<.002	na	100	348	na	na	0.04
Jul-02	**BPC3**	0.5	na	0.076	<.01	<.2	<.01	0.003	na	124	352	na	na	0.06
Aug-02	**BPC3**	1.48	na	0.089	<.01	<.2	<.01	0.003	na	134	480	na	na	<DL
Sep-02	**BPC3**	0.67	na	0.066	<.01	<.1	<.01	<.002	na	153	532	na	na	<DL
	samples analyzed	87	na	87	87	87	87	87	na	87	87	na	na	87
	detects	87	na	87	2	0	2	35	na	87	87	na	na	73
	% detects	100	na	100	2	0	2	40	na	100	100	na	na	84
	min	0.5	na	0.06	0.01	-	0.01	0.002	na	68	284	na	na	0.01
	max	4.33	na	0.27	0.01	-	0.01	0.33	na	272	2244	na	na	0.38
	mean	2	na	0.2	0.01	-	0.01	0.03	na	195	835	na	na	0.09

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F	Cl	NO_3-N	SO_4	Hg*	La*	Sc*	Zr*	IDC*	DOC*	TDC*	Hardness*	NO2-N*
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC3**	na	342	2.07	91.9	0.051	<2	<3	NA	50.8	116	167	487	<DL
Apr-94	**BPC3**	na	394	0.85	92.6	<.05	<.002	<.003	<.01	53.3	107	161	495	<.01
May-94	**BPC3**	na	341	0.18	116	<0.05	<2	<.3	<.01	36.8	88	125	456	<0.01
Jun-94	**BPC3**	na	92.7	0.94	41.3	<0.05	<2	<.3	<.01	9.2	43	52.6	85	<0.01
Jul-94	**BPC3**	na	201	0.39	109	<DL	<.005	<.005	<.01	5.1	9.1	14.2	411	<DL
Aug-94	**BPC3**	na	264	0.17	81.5	<DL	<.002	<.003	<.01	52.9	18.2	71.1	414	<DL
Sep-94	**BPC3**	na	238	0.17	83.3	<DL	<.002	<.003	NA	56.3	30.8	87.1	400	<DL
Oct-94	**BPC3**	na	102	2.57	50.2	<DL	<.002	<.003	NA	31.1	23.5	54.6	195	<DL
Nov-94	**BPC3**	na	192	4.01	89	<DL	<.002	<.003	<.01	62.3	11.6	73.9	346	<DL
Dec-94	**BPC3**													
Jan-95	**BPC3**	na	1232	2.28	77.3	<DL	<.002	<.003	<.01	41.6	33.8	75.4	407	<DL
Feb-95	**BPC3**	na	349	2.17	84.3	<DL	<.005	<.005	<.01	60	1.3	61.3	488	<DL
Mar-95	**BPC3**	na	314	0.94	57.3	<DL	<.002	<.003	<.02	33.2	16.2	49.4	254	<DL
Apr-95	**BPC3**	na	230	2.6	86.2	<DL	<.002	<.003	<.02	59.5	11.1	70.6	427	<DL
May-95	**BPC3**	na	199	2.95	75.5	<DL	<.003	<.003	<.01	66.1	62.7	128.8	413	<DL
Jun-95	**BPC3**													
Jul-95	**BPC3**													
Aug-95	**BPC3**													
Sep-95	**BPC3**													
Oct-95	**BPC3**													
Nov-95	**BPC3**	na	316	3.7	114	<DL	<2	<3	<.01	49	29.4	78.3	440	<DL
Dec-95	**BPC3**	na	371	2.64	123	<DL	<.002	<.003	<.01	57.5	36.6	94.1	605	<DL
Jan-96	**BPC3**	na	348	3.41	120	<DL	<.002	<.003	<.01	52.3	38.4	90.7	525	<DL
Feb-96	**BPC3**	na	419	2.62	122	<DL	<.002	<.003	<.01	54.2	29	83.2	538	<DL
Mar-96	**BPC3**	na	658	1.57	105	<DL	<.002	<.003	<.01	44.4	44.9	89.4	501	<DL
Apr-96	**BPC3**	na	396	1.27	76.8	0.05	<.002	<.003	<.01	34.5	40.6	75.1	356	<DL
May-96	**BPC3**	na	268	2.83	86.3	<DL	<.002	<.003	<.01	34.3	39.7	74.1	372	<DL
Jun-96	**BPC3**	na	245	5.4	86.8	0.09	<.002	<.003	<.01	50.6	33.2	83.9	468	<DL
Jul-96	**BPC3**	na	179	3.78	66.9	<DL	<.002	<.003	<.01	40	36.6	76.7	362	<DL
Aug-96	**BPC3**	na	152	0.31	66.6	<DL	<.002	<.007	<.01	33	32.6	65.6	355	<DL
Sep-96	**BPC3**	na	100	0.3	68.9	<DL	<.002	<.003	<.01	22.4	10.3	32.7	213	<DL
Oct-96	**BPC3**	na	128	0.46	69.7	<DL	<.002	<.003	<.01	34.6	11.6	46.2	263	<DL
Nov-96	**BPC3**	na	264	1.3	102	0.08	<.002	<.003	<.01	55.9	23.6	79.5	464	<DL
Dec-96	**BPC3**	na	277	1.4	58.4	<DL	<.002	<.003	<.01	30.6	15.3	46	263	<DL
Jan-97	**BPC3**	na	396	5.53	45	<DL	<.002	<.003	<.01	44.3	20.6	64.9	468	0.04
Feb-97	**BPC3**	na	204	3.24	55	0.17	<.002	<.003	<.01	36.4	15.3	51.6	293	<DL
Mar-97	**BPC3**	na	323	2.7	93.7	<DL	<.002	<.003		47.6	15.1	62.7	471	<DL
Apr-97	**BPC3**	na	334	1.79	94.5	0.05	<.005	<.003		53.8	27.2	81.1	481	<DL
May-97	**BPC3**	na	317.98	0.86	87.3	0.14	<.005	<.003		44	30	73.9	481	<DL
Jun-97	**BPC3**	na	310.88	0.69	78.5	<DL	<.002	<.003		51.4	24.5	75.9	403	<DL
Jul-97	**BPC3**	na	279.24	0.25	84.1	<DL	<.002	<.003		47.7	30.7	78.5	453	<DL
Aug-97	**BPC3**	na	154	1.82	66.7	<DL	<.002	<.003		43.6	2.9	46.6	346	<DL
Sep-97	**BPC3**	na	248.56	0.1	86.7	<DL	<.002	<.003		46.7	28	74.7	396	<DL
Oct-97	**BPC3**	na	255.26	0.66	154	<DL	<.002	<.003		39.4	27.2	66.6	392	<DL
Nov-97	**BPC3**	na	345.65	0.27	87.2	<DL	<.002	<.003		43.2	30.2	73.4	399	<DL
Dec-97	**BPC3**	na	268.5	1.02	82.6	<DL	<.002	<.003		40.5	28.8	69.3	406	<DL
Jan-98	**BPC3**	na	381.1	1.49	91.3	<DL	<.002	<.003		36.6	19.6	56.2	492	<DL
Feb-98	**BPC3**	na	269.36	1.86	85.8	<DL	<.002	<.003		34.8	2.4	37.1	357	<DL
Mar-98	**BPC3**	na	236.16	1.98	79.3	<DL	<.002	<.003		34.1	7.1	41.2	370	<DL
Apr-98	**BPC3**	na	183	1.12	65.7	<DL	<.002	<.003		30.3	4.8	35.1	298	<DL
May-98	**BPC3**	na	194.4	1.67	72.5	0.58	<.002	<.003		42.9	31.7	74.6	368	<DL
Jun-98	**BPC3**	na	192	1.84	86.3	<DL	<.002	<.003		40.4	31.7	72	367	<DL
Jul-98	**BPC3**	na	78.1	0.08	52.4	<DL	<.002	<.003		29	22.7	51.6	261	<DL
Aug-98	**BPC3**	na	107	0.04	46.9	0.08	<.002	<.003		24.7	32	56.6	213	<DL
Sep-98	**BPC3**	na	76.86	0.27	49.7	<DL	<.002	<.003		23.3	22.6	45.9	215	<DL
Oct-98	**BPC3**	na	113.605	0.96	68.4	<DL	<.002	<.003		31.9	37.8	69.7	320	<DL
Nov-98	**BPC3**	na	156	1.21	78.8	0.41	<.002	<.003		36.5	53.7	90.3	382	<DL
Dec-98	**BPC3**													
Jan-99	**BPC3**	na	772	1.18	89.4	<DL	<.002	<.003		34	17.4	51.4	505	<DL
Feb-99	**BPC3**	na	453	1.25	96	<DL	<.002	<.003		59.7	12.4	72.1	443	<DL
Mar-99	**BPC3**	na	320	1.32	99.1	<DL	<.002	<.003		53.3	11.7	65	449	<DL
Apr-99	**BPC3**													
May-99	**BPC3**													
Jun-99	**BPC3**													
Jul-99	**BPC3**	na	201	0.22	76	<DL	<.002	<.003		48.1	17.9	66	361	<DL
Aug-99	**BPC3**	na	157	0.12	86.4	<DL	<.002	<.003		42.5	16.9	59.3	348	<DL
Sep-99	**BPC3**	na	88	0.31	51.2	<DL	<.002	<.003		25.7	22.2	48	190	<DL
Oct-99	**BPC3**	na	166	<DL	100	<DL	<.002	<.003		50.7	23.4	74.1	424	<DL
Nov-99	**BPC3**													
Dec-99	**BPC3**	na	174	0.28	86.6	<DL	<.002	<.003		44.3	17.1	61.4	337	<DL
Jan-00	**BPC3**	na	391	0.31	98.6	<DL	<.002	<.003		38.9	15.7	54.6	361	<DL
Feb-00	**BPC3**	na	928	0.93	87.8	<DL	<.002	<.003		33	19.7	52.7	475	<DL
Mar-00	**BPC3**	na	629	0.28	100	<DL	<.002	<.003		41.9	24.1	65.9	509	<DL
Apr-00	**BPC3**	na	218	2.14	71.1	<DL	<.002	<.003		33.3	19	52.3	323	<DL
May-00	**BPC3**	na	150	2.42	58.9	<DL	<.002	<.003		37.5	19.5	57	304	<DL
Jun-00	**BPC3**	na	116	1.59	45	<DL	<.002	<.003		32.8	19.4	52.1	235	<DL
Jul-00	**BPC3**	na	228	0.5	65.2	<DL	<.002	<.003		43.9	20.5	64.4	369	<DL
Aug-00	**BPC3**	na	174	0.23	76.6	<DL	<.002	<.003		37.3	18.1	55.4	310	<DL
Sep-00	**BPC3**	na	225	0.48	89.2	<DL	<.002	<.003		35	19.2	54.2	296	<DL
Oct-00	**BPC3**	na	178	0.24	71.4	<DL	<.002	<.003		43.7	18.1	61.8	355	<DL
Nov-00	**BPC3**	na	240	1.3	102	<DL	<.002	<.003		61.3	12	73.3	474	<DL
Dec-00	**BPC3**													
Jan-01	**BPC3**													
Feb-01	**BPC3**	na	379	1.77	63.7	<DL	<.002	<.003		35.7	12.6	48.3	304	<DL
Mar-01	**BPC3**	na	376	1.65	90.7	<DL	<.002	<.003		56.4	15.7	72.1	480	<DL
Apr-01	**BPC3**	na	358	0.81	79.4	<DL		<.003		32.1	20.4	52.5	282	<DL
May-01	**BPC3**	na	337	0.76	73.5	0.19		<.003		44.7	30.5	75.3	391	<DL
Jun-01	**BPC3**	na	318	0.3	67.2	0.21		<.003		44.3	27.7	72	370	<DL
Jul-01	**BPC3**	na	54	0.02	58.8	0.33		<.003		23.3	7	30.3	180	<DL
Aug-01	**BPC3**	na	191	0.07	53.6	0.1		<.003		34.3	5.5	39.7	263	<DL
Sep-01	**BPC3**													
Oct-01	**BPC3**	na	147	0.85	52.9	<DL		<.003		38.7	6.3	45	283	<DL
Nov-01	**BPC3**													
Dec-01	**BPC3**	na	196	0.51	67.7	0.07		<.003		49.5	0.6	50	348	<DL
Jan-02	**BPC3**													
Feb-02	**BPC3**	na	480	0.32	82.4	<DL		<.003		53.4	4.3	57.7	471	<DL
Mar-02	**BPC3**	na	388	1.37	78.9	0.06		<.003		44.4	4.9	49.3	399	<DL
Apr-02	**BPC3**	na	246	0.96	47.6	<DL		<.003		21.6	0.2	21.7	211	<DL
May-02	**BPC3**	na	211	0.35	37.8	<DL		<.003		17.9	3.1	21	153	<DL
Jun-02	**BPC3**	na	121	0.28	29.1	<DL		<.003		20.2	5.3	25.5	132	<DL
Jul-02	**BPC3**	na	129	0.08	28.5	<DL		<.003		18.3	3	21.2	181	<DL
Aug-02	**BPC3**	na	145	0.2	42.4	<DL		<.003		28.6	8.7	37.3	217	<DL
Sep-02	**BPC3**	na	170	0.14	49.8	0.11		<.003		36.5	11.3	47.7	140	<DL
	samples analyzed	na	87	87	87	87	72	87	27	87	87	87	87	87
	detects	na	87	86	87	17	0	0	0	87	87	87	87	1
	% detects	na	100	99	100	20	0	0	0	100	100	100	100	1
	min	na	54	0.02	28.5	0.05	-	-	-	5.1	0.2	14.2	85	0.04
	max	na	1232	5.53	154	0.58	-	-	-	66.1	116	167	605	0.04
	mean	na	277	1	78	0.2	-	-	-	40	24	64	362	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC5**	7.08	1220		1		<.02	<.1	0.09	0.06	<1	124	<.01	<.01	<.01
Apr-94	**BPC5**	7.34	1716	9.6	12		<.3	<.1	0.1	0.06	<.001	117	<.01	<.01	<.01
May-94	**BPC5**	7.25	1631	11.0	0		<.02	<.1	0.06	0.06	<1	118	<.01	<.01	<.01
Jun-94	**BPC5**	7.10	1569	10.8	1		0.04	<.1	<.01	0.05	<1	116	<.01	<.01	<.01
Jul-94	**BPC5**	7.39	1566	10.9	2		<.02	<.1	0.08	0.06	<.001	120	<.02	<.02	<.01
Aug-94	**BPC5**	7.38	1500	11.2	1		0.04	<.1	0.08	0.06	<.001	117	<.01	<.01	<.01
Sep-94	**BPC5**	7.28	1595	10.5	1		0.03	<.1	0.09	0.05	<.001	116	<.01	<.01	<.01
Oct-94	**BPC5**	7.24	1611	9.4	1		<.1	<.1	0.11	0.05	0.002	111	<.01	<.01	0.01
Nov-94	**BPC5**	7.32	1671	8.6	2		0.04	<.1	0.09	0.05	<.001	106	<.01	<.01	<.01
Dec-94	**BPC5**														
Jan-95	**BPC5**	7.20	1601	9.7	1		0.02	<.1	0.11	0.05	<.001	112	<.01	<.01	<.01
Feb-95	**BPC5**	7.16	1720	9.5	0		0.04	<.1	0.08	0.05	<.002	108	<.01	<.01	<.01
Mar-95	**BPC5**	7.15	1541	9.8	0		0.04	<.1	0.07	0.06	<.001	116	<.01	<.01	<.01
Apr-95	**BPC5**	7.22	1623	11.6	0		<.02	<.1	0.11	0.06	<.001	115	<.01	<.01	<.01
May-95	**BPC5**	7.38	1444	12.1	1		<.02	<.1	0.08	0.05	<.001	104	<.01	<.01	<.01
Jun-95	**BPC5**														
Jul-95	**BPC5**														
Aug-95	**BPC5**														
Sep-95	**BPC5**														
Oct-95	**BPC5**														
Nov-95	**BPC5**	7.08	1610	8.0	1		0.06	<.1	0.08	0.05	<1	106	<.01	<.01	<.01
Dec-95	**BPC5**	7.02	1614	8.6	0		<.01	<.1	0.11	0.06	<.001	128	<.01	<.01	<.01
Jan-96	**BPC5**	7.27	2297	7.1	12		<.02	<.1	0.1	0.06	<.002	127	<.01	<.01	<.01
Feb-96	**BPC5**	7.17	2266	8.7	0		0.04	<.1	0.09	0.06	<.002	122	<.01	<.01	<.01
Mar-96	**BPC5**	7.09	2294	10.0	0		0.04	<.1	<.02	0.06	<.001	107	<.01	<.01	<.01
Apr-96	**BPC5**	7.11	1944	10.9	0		0.05	<.1	0.09	0.08	<.001	125	<.01	<.01	<.01
May-96	**BPC5**	7.94	1292	11.4	0		0.04	<.1	0.07	0.07	<.001	121	<.01	<.01	<.01
Jun-96	**BPC5**	7.92	1640	11.3	0		<.02	<.1	0.09	0.06	<.001	118	<.01	<.01	<.01
Jul-96	**BPC5**	7.76	1590	11.3	1		<.02	<.1	0.1	0.06	<.001	113	<.01	<.01	<.01
Aug-96	**BPC5**	7.43	1520	11.2	1		<DL	<.1	0.1	0.06	<.001	118	<.01	<.01	<.01
Sep-96	**BPC5**	7.14	619	12.6	586		0.04	<.1	0.06	0.04	<.001	68.2	<.01	<.01	<.01
Oct-96	**BPC5**	7.06	763	10.0	0		<.03	<.1	0.09	0.05	<.001	102	<.01	<.01	<.01
Nov-96	**BPC5**	7.17	749	9.3	1		<.02	<.1	0.09	0.05	<.001	102	<.01	<.01	<.01
Dec-96	**BPC5**	6.99	761	4.4	1		<.01	<.1	0.07	0.05	<.001	110	<.01	<.01	<.01
Jan-97	**BPC5**	7.65	1119				0.05	<.1	0.08	0.07	<.001	127	<.01	<.01	<.01
Feb-97	**BPC5**	7.27	736	8.5	1		<.02	<.2	0.09	0.06	<.001	118	<.01	<.01	<.01
Mar-97	**BPC5**	7.32	892	9.9	1		<.02	<.1	0.1	0.06	<DL	126	<.01	<.01	<.01
Apr-97	**BPC5**	7.41	853	10.9	2		<.03	<.1	0.07	0.06	<.001	110	<.01	<.01	<.01
May-97	**BPC5**	7.41	748	10.2	1		<.04	<.2	0.12	0.06	<.002	110	<.01	<.01	<.01
Jun-97	**BPC5**	7.39	755	10.6	1		<.02	<.1	0.08	0.06	<.002	105	<.01	<.01	<.01
Jul-97	**BPC5**	7.03	1120	11.1	1		<.02	<.1	0.08	0.08	<.001	126	<.01	<.01	<.01
Aug-97	**BPC5**	7.55	871	11.0	13		<.02	<.1	0.09	0.06	<.001	118	<.01	<.01	<.01
Sep-97	**BPC5**	7.45	776	10.3	18		<.02	<.2	0.07	0.06	<.001	113	<.01	<.01	<.01
Oct-97	**BPC5**	7.62	789	10.2	5		<.02	<.2	0.07	0.06	<.001	111	<.01	<.01	<.01
Nov-97	**BPC5**	7.43	1214	8.3	1		<.02	<.3	0.09	0.06	<.002	114	<.01	<.01	<.01
Dec-97	**BPC5**	7.48	1067	8.7	4		<.02	<.3	0.09	0.06	<.002	114	<.01	<.01	0.01
Jan-98	**BPC5**	7.41	1129	8.8	8		0.02	<.1	0.12	0.07	<.001	142	<.01	<.01	<.01
Feb-98	**BPC5**	7.47	1108	10.4	3		<.02	<.2	0.08	0.06	<.001	115	<.01	<.01	<.01
Mar-98	**BPC5**	7.48	1272	12.0	2		<.02	<.1	0.08	0.06	<.001	118	<.01	<.01	<.01
Apr-98	**BPC5**	7.35	1002	11.0	3		<.02	<.1	0.07	0.06	<.001	112	<.01	<.01	<.01
May-98	**BPC5**	7.23	1015	10.8	1		<.02	<.1	0.08	0.05	<.001	104	<.01	<.01	<.01
Jun-98	**BPC5**	7.20	880	10.8	2		<.02	<.1	0.09	0.05	<.001	101	<.01	<.01	<.01
Jul-98	**BPC5**	7.37	974	11.0	2		0.04	<.1	0.07	0.05	<.001	104	<.02	<.01	<.01
Aug-98	**BPC5**	7.36	1089	11.0	3		0.03	<.1	0.08	0.05	<.001	104	<.02	<.01	<.01
Sep-98	**BPC5**	7.39	469	14.2	1		<.02	<.1	0.09	0.05	<.003	105	<.01	<.01	<.01
Oct-98	**BPC5**	7.71	1105	10.8	4		<.02	<.1	0.1	0.05	<.001	106	<.01	<.01	<.01
Nov-98	**BPC5**	7.52	973	9.2	11		0.03	<.1	0.08	0.05	<.001	108	<.01	<.01	<.01
Dec-98	**BPC5**														
Jan-99	**BPC5**	6.74	1003	9.2	5		<.01	<.1	0.07	0.06	<.001	120	<.01	<.01	<.01
Feb-99	**BPC5**	6.27	1007	9.4	8		0.03	<.1	0.06	0.05	<.002	111	<.01	<.01	<.01
Mar-99	**BPC5**	6.61	1007	10.1	4		<.01	<.1	0.07	0.06	<.002	114	<.01	<.01	<.01
Apr-99	**BPC5**														
May-99	**BPC5**														
Jun-99	**BPC5**														
Jul-99	**BPC5**	7.75	951	19.0	6		<.02	<.1	0.09	0.06	<.001	101	<.01	<.01	<.01
Aug-99	**BPC5**	7.23	934	14.6	29		<.02	<.1	0.08	0.05	<.003	103	<.01	<.01	<.01
Sep-99	**BPC5**	7.51	880	11.5	79		0.03	<.1	0.07	0.05	<.001	105	<.01	<.01	<.01
Oct-99	**BPC5**	7.40		10.0			0.03	<.1	0.09	0.05	<.002	107	<.01	<.01	<.01
Nov-99	**BPC5**														
Dec-99	**BPC5**	7.91	959	7.1	0		<.02	<.2	0.07	0.05	<.001	85.7	<.01	<.01	<.01
Jan-00	**BPC5**	7.73	1068	5.2	6		<.02	<.2	0.07	0.05	<.001	109	<.01	<.01	<.01
Feb-00	**BPC5**	7.72	909	7.8	238		<DL	<.2	0.09	0.047	<.001	92.7	<.01	<.01	<.01
Mar-00	**BPC5**	7.82	1235	8.2	7		<DL	<.1	0.07	0.065	<.001	123	<.02	<.01	<.01
Apr-00	**BPC5**	7.73	947	13.2	53		<.02	<.1	0.07	0.028	<.001	63.7	<.01	<.01	<.01
May-00	**BPC5**	7.79	1218	12.5	29		<.02	<.1	0.07	0.062	<.001	113	<.01	<.01	<.01
Jun-00	**BPC5**	7.90	1105	14.5	59		<.01	<.1	0.07	0.055	<.001	98.2	<.01	<.01	<.01
Jul-00	**BPC5**	7.74	1180	13.6	20		<.01	<.1	0.08	0.071	<.001	107	<.01	<.01	<.01
Aug-00	**BPC5**	7.67	1153	13.9	23		<.01	<.2	0.084	0.072	<.001	104	<.01	<.01	<.01
Sep-00	**BPC5**	7.70	1121	12.0	21		<.1	<.2	0.08	0.016	<.001	61.8	<.01	<.01	<.01
Oct-00	**BPC5**	7.52	1122	11.6	3		<.1	<.2	0.08	0.053	<.001	104	<.01	<.01	<.01
Nov-00	**BPC5**	7.48	1118	4.8	70		<.02	<.05	0.102	0.05	<.001	111	<.01	<.01	<.01
Dec-00	**BPC5**														
Jan-01	**BPC5**	7.41	1150	4.8	3		<.3	<.1	0.08	0.05	<.001	110	<.01	<.01	<.01
Feb-01	**BPC5**	7.42	1079	6.6	13		<.3	<.1	0.07	0.05	<.001	107	<.01	<.01	<.01
Mar-01	**BPC5**	7.83	1162	9.9	4		<.3	<.1	0.08	0.054	<.001	118	<.01	<.01	<.01
Apr-01	**BPC5**	8.01	1050	13.5	16		<.02	<.1	0.06	0.024	<.001	64.5	<.01	<.01	<.01
May-01	**BPC5**	7.75	1180	10.8	13		<.01	<.1	0.1	0.056	<.001	115	<.01	<.01	<.01
Jun-01	**BPC5**	7.64	1200	12.5	10		<DL	<.1	0.08	0.055	<.001	117	<.01	<.01	<.01
Jul-01	**BPC5**	7.62	1200	14.6	35		<DL	<.1	0.07	0.054	<.001	114	<.01	<.01	<.01
Aug-01	**BPC5**	7.43	1212	14.0	9		<DL	<.2	0.08	0.058	<.001	116	<.01	<.01	<.01
Sep-01	**BPC5**	7.36	1169	11.0	16		<.01	<.2	0.09	0.056	<.001	119	<.01	<.01	<.01
Oct-01	**BPC5**	7.69	1168	10.0	4		<.02	<.2	0.08	0.035	<.003	77.4	<.01	<.01	<.04
Nov-01	**BPC5**														
Dec-01	**BPC5**	7.76	1085	6.5	7		<.02	<.2	0.11	0.054	<.003	108	<.01	<.01	<.04
Jan-02	**BPC5**														
Feb-02	**BPC5**	7.20	1124	7.8	7		<.02	<.1	0.1	0.061	<.001	119	<.01	<.01	<.01
Mar-02	**BPC5**	7.45	1016	9.8	18		<.02	<.1	0.08	0.052	<.001	103	<.01	<.01	<.01
Apr-02	**BPC5**	7.89	1021	10.7	37		<.1	<.1	0.08	0.025	<.001	52.9	<.01	<.01	<.01
May-02	**BPC5**	6.86	966	11.4	44		<.1	<.1	0.08	0.024	<.001	48.3	<.01	<.01	<.01
Jun-02	**BPC5**	7.03	1028	12.2	312		<.02	<.1	0.07	0.025	<.002	56.9	<.01	<.01	<.01
Jul-02	**BPC5**	7.91	1243	14.2	26		<.02	<.1	0.03	0.02	<.002	56.2	<.01	<.01	<.01
Aug-02	**BPC5**	7.68	1131	13.3	22		<.02	<.1	0.07	0.055	<.002	115	<.01	<.01	<.01
Sep-02	**BPC5**	7.43	1093	13.5	26		<.01	<.1	0.07	0.015	<.001	38.9	<.01	<.01	<.01
	samples analyzed						89	89	89	89	89	89	89	89	89
	detects						21	0	87	89	1	89	0	0	2
	% detects						24	0	98	100	1	100	0	0	2
	min	6.27	469	4.4	0		0.02	-	0.03	0.015	0.002	38.9	-	-	0.01
	max	8.01	2297	19.0	586		0.06	-	0.12	0.08	0.002	142	-	-	0.01
	mean	7.41	1195	11	23		0.04	-	0.08	0.05	-	106.4	-	-	0.01

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	Ni mg/L	P mg/L	Pb mg/L	S mg/L	Sb mg/L	Se mg/L
		0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC5**	<.01	<.01	3	0.01	64.7	0.01	<.01	53.7	<.03	<DL	<.08	na	<.1	<.1
Apr-94	**BPC5**	<.01	<.01	3	0.01	61.3	0.01	<.01	61.8	<.03	<.01	<.08	na	<.1	<.1
May-94	**BPC5**	<.01	<.01	2	0.01	61.3	0.01	<.01	62.3	<.03	0.03	<.08	na	<.1	<.1
Jun-94	**BPC5**	<.01	<.01	2	0.01	60.0	0.01	<.01	60.1	<.03	0.02	<.08	na	<.1	0.2
Jul-94	**BPC5**	<.01	<.01	2	0.01	61.8	0.01	<.02	59.4	<.04	<DL	<.04	na	<.2	<.2
Aug-94	**BPC5**	<.01	<.01	4	0.01	61.1	0.01	<.02	55.5	<.03	0.14	<.08	na	<.1	<.1
Sep-94	**BPC5**	<.01	<.01	2	0.01	60.3	0.01	<.02	53.5	<.03	0.06	<.05	na	<.1	<.2
Oct-94	**BPC5**	<.01	<DL	3	0.01	53.5	0.01	<.02	48	<.03	0.01	<.05	na	<.2	<.2
Nov-94	**BPC5**	<.01	<.01	3	0.01	52.8	0.01	<.02	46.8	<.03	0.01	<.06	na	<.1	<.2
Dec-94	**BPC5**														
Jan-95	**BPC5**	<.01	<.01	2	0.01	53.9	0.01	<.02	47.8	<.03	0.02	<.05	na	<.3	<.1
Feb-95	**BPC5**	<.01	<.01	3	0.01	53.3	0.01	<.02	51.8	<.02	<DL	<.04	na	<.1	<.1
Mar-95	**BPC5**	<.01	<.01	3	0.01	55.5	0.01	<.02	50.2	<.03	0.02	<.05	na	<.2	<.1
Apr-95	**BPC5**	<.01	<.01	<1	0.01	54.9	0.01	<.02	52	<.03	<DL	<.05	na	<.2	<.1
May-95	**BPC5**	<.01	<.01	2	0.01	51.5	0.01	<.02	49.9	<.03	<DL	<.08	na	<.1	<.1
Jun-95	**BPC5**														
Jul-95	**BPC5**														
Aug-95	**BPC5**														
Sep-95	**BPC5**														
Oct-95	**BPC5**														
Nov-95	**BPC5**	0.07	<.01	<1	0.01	53.2	0.01	<.02	43.5	<.03	0.01	<.05	na	<.2	<.2
Dec-95	**BPC5**	<.01	<.01	4	0.02	62.5	0.01	<.02	52.3	<.03	0.01	<.05	na	<.2	<.1
Jan-96	**BPC5**	<.01	<.01	<1	0.01	61.4	0.02	<.02	56	<.03	0.06	<.05	na	<.2	<.1
Feb-96	**BPC5**	<.01	<.01	4	0.01	59.3	<.01	<.02	58.2	<.03	0.06	<.08	na	<.1	<.1
Mar-96	**BPC5**	<.01	<DL	3	0.01	54.0	0.01	<.02	191	<.03	<DL	<.04	na	<.1	<.1
Apr-96	**BPC5**	<.01	<.01	3	0.01	61.7	0.01	<.02	89.1	<.03	0.01	<.05	na	<.1	<.2
May-96	**BPC5**	<DL	<.01	3	0.01	58.5	<.01	<.02	89.3	<.03	<DL	<.05	na	<.2	<.1
Jun-96	**BPC5**	0.05	<DL	2	<.01	56.4	0.02	<.02	86.8	<.03	0.02	<.05	na	<.2	<.2
Jul-96	**BPC5**	0.02	<.01	3	0.01	54.6	0.01	<.02	81.7	<.03	<DL	<.04	na	<.2	<.2
Aug-96	**BPC5**	0.02	<.01	3	<.03	56.6	<.01	0.03	77.3	<.03	0.02	<.05	na	<.2	<.2
Sep-96	**BPC5**	<.01	<.01	7	<.01	32.5	0.01	<.02	45.2	<.03	0.04	<.05	na	<.2	<.2
Oct-96	**BPC5**	0.02	<.01	2	<.01	50.0	<.01	<.02	65.4	<.03	0.07	<.05	na	<.2	<.2
Nov-96	**BPC5**	<DL	<.01	3	<.01	49.7	<.01	<.02	65.9	<.03	0.02	<.04	na	<.2	<.2
Dec-96	**BPC5**	<.01	<.03	4	0.01	52.3	<.01	<.02	67.5	<.03	0.02	<.05	na	<.2	<.2
Jan-97	**BPC5**	<DL	<.1	3	<.01	61.2	<.01	<.02	85.4	<.03	0.01	<.05	na	<.2	<.2
Feb-97	**BPC5**	0.05	<.03	2	<.01	57.7	<.01	<.02	76.4	<.03	0.05	<.05	na	<.2	<.2
Mar-97	**BPC5**	<.01	<DL	4	<.01	58.7	<.01	<.02	81.1	<.03	0.03	<.05	na	<.2	<.2
Apr-97	**BPC5**	<.01	<.01	3	0.01	52.9	<.01	<.01	71.9	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC5**	<.02	<.01	3	<.01	54.0	0.01	<.02	76	<.03	0.01	<.05	na	<.2	<.2
Jun-97	**BPC5**	<.02	<.01	<1	<.01	52.1	0.01	<.02	75.8	<.03	0.05	<.05	na	<.2	<.1
Jul-97	**BPC5**	<.01	<.01	4	0.01	54.5	0.01	<.01	76.5	<.03	<DL	<.05	na	<.2	<.2
Aug-97	**BPC5**	<.01	<.01	<1	<.01	56.0	<.01	<.02	73.3	<.03	<DL	<.05	na	<.2	<.2
Sep-97	**BPC5**	<.01	<.01	4	0.01	52.6	<.01	<.02	62.1	<.03	<DL	<.05	na	<.2	<.1
Oct-97	**BPC5**	<.01	<.01	3	0.01	50.7	0.01	<.02	62.9	<.03	<DL	<.05	na	<.2	<.1
Nov-97	**BPC5**	<.02	<.01	2	0.01	53.8	0.01	<.02	78.5	<.03	0.04	<.05	na	<.2	<.2
Dec-97	**BPC5**	<.02	<.01	2	0.01	52.4	0.01	0.09	70	<.03	0.02	<.05	na	<.2	<.2
Jan-98	**BPC5**	<.01	<.01	3	0.01	66.6	0.01	<.02	94.9	<.03	0.02	<.05	na	<.1	<.2
Feb-98	**BPC5**	<.01	<.02	3	0.01	54.2	<.01	<.02	70.6	<.03	0.01	<.05	na	<.2	<.1
Mar-98	**BPC5**	<.01	<.01	3	0.01	55.2	0.01	<.01	72.9	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC5**	<.01	<.01	2	0.01	52.9	<.01	<.02	70.3	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC5**	<.01	<.01	3	0.01	49.0	0.01	<.02	64.6	<.03	0.01	<.05	na	<.1	<.2
Jun-98	**BPC5**	<.01	<.01	<1	0.01	47.4	0.01	<.02	58.7	<.03	0.03	<.05	na	<.1	<.2
Jul-98	**BPC5**	<.03	<.01	3	<.02	49.7	0.01	<.02	59.4	<.03	0.06	<.05	na	<.3	<.2
Aug-98	**BPC5**	<.03	<.01	<2	<.02	51.1	<.01	<.02	58.6	<.03	0.03	<.05	na	<.3	<.2
Sep-98	**BPC5**	<.01	<.01	4	0.01	51.0	0.01	0.03	56	<.03	0.03	<.07	na	<.2	<.1
Oct-98	**BPC5**	<.01	<.01	2	0.01	50.6	<.01	<.02	59.1	<.03	<DL	<.05	na	<.2	<.2
Nov-98	**BPC5**	<.01	<.01	<1	0.01	51.3	0.01	<.02	56.7	<.03	0.04	<.05	na	<.2	<.2
Dec-98	**BPC5**														
Jan-99	**BPC5**	<.01	<.01	<1	<.01	54.1	<.01	<.02	74.2	<.03	<DL	<.05	na	<.2	<.1
Feb-99	**BPC5**	<.01	<.01	4	0.01	52.7	0.01	<.02	59	<.03	<DL	<.03	na	<.2	<.2
Mar-99	**BPC5**	<.01	<.01	4	<.01	54.7	<.01	<.02	67.4	<.03	<DL	<.03	na	<.2	<.2
Apr-99	**BPC5**														
May-99	**BPC5**														
Jun-99	**BPC5**														
Jul-99	**BPC5**	<.01	<.01	5	<.01	49.4	<.01	<.02	66.3	<.03	0.06	<.05	na	<.1	<.1
Aug-99	**BPC5**	<.01	<.01	2	<.01	50.1	<.01	<.02	55.9	<.02	<DL	<.05	na	<.2	<.2
Sep-99	**BPC5**	<.01	<.01	3	<.05	48.6	<.01	<.02	40.4	<.03	0.02	<.05	na	<.3	<.2
Oct-99	**BPC5**	<.01	<.01	3	0.01	52.4	<.01	<.02	58	<.03	0.06	<.05	na	<.3	<.2
Nov-99	**BPC5**														
Dec-99	**BPC5**	<.01	<.01	4	0.01	39.6	<.01	<.02	69.2	<.03	0.19	<.05	na	<.1	<.2
Jan-00	**BPC5**	<.01	<.01	3	<.01	50.4	<.01	<.02	59.7	<.1	0.04	<.05	na	<.2	<.2
Feb-00	**BPC5**	<.01	<.01	5	0.01	43.1	0.001	<.02	65	<.01	0.04	<.02	na	<.05	<.05
Mar-00	**BPC5**	<.01	<.01	3	0.01	60.2	0.008	<.01	88.2	0.01	<DL	<.03	na	<.1	<.1
Apr-00	**BPC5**	<.01	<.01	2	<.01	49.1	0.007	<.01	70.4	<.01	<DL	<.02	na	<.1	<.1
May-00	**BPC5**	<.01	<.01	4	0.01	53.1	0.022	<.01	83.2	<.01	0.01	<.02	na	<.1	<.1
Jun-00	**BPC5**	0.003	0.02	3	<DL	47.1	0.014	<.01	75.4	<.01	<DL	<.03	na	<.1	<.1
Jul-00	**BPC5**	<.01	<.01	3	0.01	50.9	0.022	<.02	83.8	<.01	<DL	<.02	na	<.1	<.1
Aug-00	**BPC5**	0.003	<.01	3	0.01	50.0	0.017	<.03	83.2	<.01	<DL	<.03	na	<.1	<.1
Sep-00	**BPC5**	<.01	<.01	<2	<.01	52.3	0.003	<.02	73	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC5**	<.01	0.02	<1	<.01	51.2	0.024	<.02	67.6	<.01	<DL	<.03	na	<.2	<.2
Nov-00	**BPC5**	<.005	<.01	4	0.01	53.0	<.001	<.01	75.9	<.01	<DL	<.02	na	<.1	<.1
Dec-00	**BPC5**														
Jan-01	**BPC5**	<.003	<.01	5	0.01	52.2	0.005	<.02	65.5	<.01	<DL	<.05	na	<.1	<.1
Feb-01	**BPC5**	<.003	<.01	5	<.01	50.7	0.006	<.02	59.9	<.01	<DL	<.05	na	<.1	<.1
Mar-01	**BPC5**	<.003	<.01	5	<.01	56.3	<.001	<.02	71.4	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC5**	<.01	<.01	4	<.01	42.3	0.008	<.02	53	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC5**	<.01	<.01	3	0.01	54.9	<.002	<.02	80.1	<.01	<DL	<.05	na	<.1	<.1
Jun-01	**BPC5**	<.01	<.01	4	0.01	54.6	<.002	<.02	84.3	<.01	<DL	<.05	na	<.1	<.1
Jul-01	**BPC5**	<.01	<.01	4	0.01	53.0	<.002	<.02	76.8	<.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC5**	<.01	<.01	4	0.01	55.3	0.004	<.01	75.3	<.01	<DL	<.05	na	<.1	<.1
Sep-01	**BPC5**	<.01	<.01	4	0.01	55.0	<.004	<.01	80	<.01	<DL	<.05	na	<.1	<.1
Oct-01	**BPC5**	<.003	<.01	3	0.01	46.7	0.018	<.01	69.3	<.01	0.01	<.02	na	<.1	<.2
Nov-01	**BPC5**														
Dec-01	**BPC5**	<.003	<.01	<1	0.01	52.9	<.001	<.01	73.8	<.01	<DL	<.02	na	<.1	<.2
Jan-02	**BPC5**														
Feb-02	**BPC5**	0.006	<.01	<1	0.01	56.8	0.009	<.05	82.5	<.01	0.02	<.03	na	<.1	<.1
Mar-02	**BPC5**	0.004	0.02	6	0.01	49.2	0.008	<.05	60.6	<.01	0.03	<.03	na	<.1	<.1
Apr-02	**BPC5**	<.01	<.01	4	0.01	34.5	0.003	<.01	48	0.01	0.07	<.02	na	<.1	<.1
May-02	**BPC5**	<.01	<.01	2	0.01	39.9	0.005	<.01	56.2	<.01	<DL	<.02	na	<.1	<.1
Jun-02	**BPC5**	<.01	<.01	4	0.01	47.5	0.009	<.01	61.1	<.01	0.02	<.05	na	<.1	<.1
Jul-02	**BPC5**	<.01	<.01	2	0.01	41.5	0.005	<.01	57.5	<.01	0.03	<.05	na	<.1	<.1
Aug-02	**BPC5**	<.01	<.01	3	0.01	51.5	0.008	<.01	65	<.01	<DL	<.05	na	<.1	<.1
Sep-02	**BPC5**	<.01	<.01	<1	<.01	26.7	0.002	<.01	34.8	<.01	<DL	<.05	na	<.1	<.1
	samples analyzed	89	89	89	89	89	89	89	89	89	89	89	na	89	89
	detects	10	3	75	63	89	58	3	89	2	49	0	na	0	1
	% detects	11	3	84	71	100	65	3	100	2	55	0	na	0	1
	min	0.003	0.02	2	0.01	26.7	0.001	0.03	34.8	0.01	0.01	-	-	-	0.2
	max	0.07	0.02	7	0.02	66.6	0.024	0.09	191	0.01	0.19	-	-	-	0.2
	mean	0.02	0.02	3	0.01	52.7	0.01	0.05	67	0.01	0.04	-	-	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC5**	6.91	na	0.34	<.01	<.1	0.01	<.01	na	342	820	na	na	<DL
Apr-94	**BPC5**	6.7	na	0.33	<.01	0.4	<.01	<.01	na	325	868	na	na	0.06
May-94	**BPC5**	6.75	na	0.32	<.01	<.3	<.01	<.01	na	334	748	na	na	<0.01
Jun-94	**BPC5**	6.64	na	0.31	<.01	<.3	<.01	<.01	na	340	812	na	na	0.09
Jul-94	**BPC5**	6.87	na	0.33	<.01	<.2	<.01	<.02	na	344	820	na	na	0.06
Aug-94	**BPC5**	6.78	na	0.32	<.01	<.3	<.01	<.01	na	335	840	na	na	0.08
Sep-94	**BPC5**	6.88	na	0.32	<.01	<.3	<.01	0.01	na	333	788	na	na	0.02
Oct-94	**BPC5**	5.91	na	0.32	<.01	<.4	<.01	<.01	na	327	884	na	na	<DL
Nov-94	**BPC5**	6	na	0.31	<.01	<.3	<.01	0.01	na	332	808	na	na	0.03
Dec-94	**BPC5**													
Jan-95	**BPC5**	6.12	na	0.32	<.01	<.3	<.01	<.01	na	329	772	na	na	0.01
Feb-95	**BPC5**	6.13	na	0.32	<.01	<.2	<.01	0.14	na	332	796	na	na	0.01
Mar-95	**BPC5**	6.09	na	0.34	<.01	<.4	<.01	0.2	na	324	720	na	na	0.01
Apr-95	**BPC5**	6.29	na	0.34	<.01	<.4	<.01	<.01	na	320	784	na	na	0.02
May-95	**BPC5**	5.98	na	0.32	<.01	<.3	<.01	0.28	na	320	696	na	na	0.02
Jun-95	**BPC5**													
Jul-95	**BPC5**													
Aug-95	**BPC5**													
Sep-95	**BPC5**													
Oct-95	**BPC5**													
Nov-95	**BPC5**	5.89	na	0.33	<.01	<.4	<.01	0.07	na	339	684	na	na	<DL
Dec-95	**BPC5**	6.7	na	0.37	<.01	<.3	<.01	0.01	na	335	740	na	na	0.06
Jan-96	**BPC5**	6.54	na	0.38	<.01	<.6	<.01	0.01	na	319	804	na	na	0.06
Feb-96	**BPC5**	6.12	na	0.37	<.01	<.3	<.01	<.01	na	323	852	na	na	<DL
Mar-96	**BPC5**	2.54	na	0.24	<.01	<.3	<.01	0.06	na	248	1216	na	na	0.09
Apr-96	**BPC5**	6.11	na	0.4	<.01	<.3	<.01	<.01	na	326	1056	na	na	0.03
May-96	**BPC5**	5.9	na	0.38	<.01	<1	<.01	0.06	na	334	924	na	na	0.02
Jun-96	**BPC5**	6.04	na	0.36	<.01	<.6	<.01	0.22	na	308	876	na	na	0.02
Jul-96	**BPC5**	6.15	na	0.34	<.01	<.2	<.01	0.02	na	320	856	na	na	0.05
Aug-96	**BPC5**	6.18	na	0.35	<.01	<.3	<.01	0.03	na	323	720	na	na	0.01
Sep-96	**BPC5**	3.97	na	0.2	<.01	<.3	<.01	0.02	na	233	544	na	na	0.05
Oct-96	**BPC5**	5.77	na	0.3	<.01	<.3	<.01	0.01	na	319	676	na	na	0.02
Nov-96	**BPC5**	5.62	na	0.3	<.01	<.3	<.01	<.01	na	317	736	na	na	<DL
Dec-96	**BPC5**	5.89	na	0.32	<.01	<.3	<.01	<.01	na	318	736	na	na	0.02
Jan-97	**BPC5**	6.62	na	0.39	<.01	<.3	<.01	<.01	na	319	784	na	na	<DL
Feb-97	**BPC5**	6.29	na	0.35	<.01	<.3	<.01	0.03	na	321	776	na	na	0.04
Mar-97	**BPC5**	6.58	na	0.37	<.01	<.3	<.01	0.02	na	322	784	na	na	0.08
Apr-97	**BPC5**	5.97	na	0.32	<.01	<0	<.01	<.01	na	316	740	na	na	<DL
May-97	**BPC5**	6.39	na	0.34	<.01	<.3	<.01	0.08	na	318	824	na	na	0.04
Jun-97	**BPC5**	6.25	na	0.32	<.01	<.3	<.01	<.01	na	318	860	na	na	<DL
Jul-97	**BPC5**	6.14	na	0.67	<.01	<.3	<.01	0.02	na	322	844	na	na	<DL
Aug-97	**BPC5**	6.41	na	0.34	<.01	<.3	<.01	<.01	na	322	764	na	na	<DL
Sep-97	**BPC5**	6.29	na	0.32	<.01	<.4	<.01	<.01	na	300	796	na	na	<DL
Oct-97	**BPC5**	5.96	na	0.31	<.01	<.4	<.01	0.03	na	323	804	na	na	<DL
Nov-97	**BPC5**	6.14	na	0.33	<.01	<.3	<.01	<.01	na	323	760	na	na	<DL
Dec-97	**BPC5**	6.05	na	0.31	<.01	<.3	<.01	<.01	na	323	780	na	na	<DL
Jan-98	**BPC5**	7.64	na	0.41	<.01	<.3	<.01	<.01	na	317	792	na	na	<DL
Feb-98	**BPC5**	5.98	na	0.31	<.01	<.2	<.01	<.01	na	322	712	na	na	0.01
Mar-98	**BPC5**	6.23	na	0.33	<.01	<.2	<.01	<.01	na	319	732	na	na	0.03
Apr-98	**BPC5**	6.18	na	0.32	<.01	<.3	<.01	<.01	na	318	776	na	na	<DL
May-98	**BPC5**	5.89	na	0.3	<.01	<.3	<.01	<.01	na	317	744	na	na	<DL
Jun-98	**BPC5**	5.9	na	0.29	<.01	<.3	<.01	<.01	na	317	676	na	na	0.02
Jul-98	**BPC5**	6.09	na	0.3	<.01	<.3	<.01	0.03	na	319	688	na	na	0.02
Aug-98	**BPC5**	6.15	na	0.31	<.01	<.3	<.01	<.01	na	332	652	na	na	0.04
Sep-98	**BPC5**	6.32	na	0.29	<.01	<.3	<.01	<.01	na	334	668	na	na	<DL
Oct-98	**BPC5**	6.22	na	0.3	<.01	<.3	<.01	0.06	na	333	648	na	na	0.11
Nov-98	**BPC5**	6.22	na	0.31	<.01	<.3	<.01	<.01	na	317	652	na	na	0.05
Dec-98	**BPC5**													
Jan-99	**BPC5**	6.55	na	0.31	<.01	<.3	<.01	<.01	na	321	700	na	na	<DL
Feb-99	**BPC5**	6.2	na	0.32	<.01	<.3	<.01	<.01	na	336	680	na	na	0.07
Mar-99	**BPC5**	6.29	na	0.35	<.01	<.3	<.01	<.01	na	327	724	na	na	0.03
Apr-99	**BPC5**													
May-99	**BPC5**													
Jun-99	**BPC5**													
Jul-99	**BPC5**	4.49	na	0.23	<.01	<.2	<.01	<.01	na	302	720	na	na	0.04
Aug-99	**BPC5**	5.48	na	0.29	<.01	<.2	<.01	<.01	na	335	628	na	na	0.04
Sep-99	**BPC5**	5.24	na	0.28	<.01	<.3	<.01	<.01	na	330	636	na	na	0.12
Oct-99	**BPC5**	5.49	na	0.3	<.01	<.3	<.01	<.01	na	306	648	na	na	0.02
Nov-99	**BPC5**													
Dec-99	**BPC5**	2.74	na	0.29	<.01	<.5	<.01	0.05	na	220	572	na	na	0.01
Jan-00	**BPC5**	5.3	na	0.28	<.01	<.3	<.01	<.01	na	296	676	na	na	<DL
Feb-00	**BPC5**	4.44	na	0.238	<.01	<.1	<.01	0.007	na	251	608	na	na	<DL
Mar-00	**BPC5**	5.21	na	0.347	<.01	<.1	<.01	0.002	na	301	760	na	na	<DL
Apr-00	**BPC5**	4.99	na	0.208	<.01	<.1	<.01	<.002	na	378	648	na	na	0.01
May-00	**BPC5**	4.92	na	0.307	<.01	<.1	<.01	0.002	na	288	776	na	na	<DL
Jun-00	**BPC5**	4.85	na	0.281	<.01	<.1	<.01	0.009	na	274	692	na	na	<DL
Jul-00	**BPC5**	5.22	na	0.306	<.01	<.1	<.01	0.01	na	281	744	na	na	<DL
Aug-00	**BPC5**	5.53	na	0.322	<.01	<.3	<.01	<.005	na	284	720	na	na	0.07
Sep-00	**BPC5**	4.63	na	0.197	<.01	<.2	<.01	<.01	na	235	624	na	na	<DL
Oct-00	**BPC5**	4.98	na	0.27	<.01	<.2	<.01	<.01	na	321	660	na	na	<DL
Nov-00	**BPC5**	5.4	na	0.277	<.01	<.1	<.01	<.002	na	315	688	na	na	<DL
Dec-00	**BPC5**													
Jan-01	**BPC5**	4.84	na	0.27	<.01	<.1	<.01	<.01	na	259	700	na	na	<DL
Feb-01	**BPC5**	4.82	na	0.255	<.01	<.1	<.01	<.01	na	288	648	na	na	0.06
Mar-01	**BPC5**	5.11	na	0.283	<.01	<.1	<.01	0.01	na	292	656	na	na	<DL
Apr-01	**BPC5**	4.42	na	0.172	<.01	<.1	<.01	<.005	na	144	772	na	na	0.02
May-01	**BPC5**	6.35	na	0.294	<.01	<.2	<.01	<.01	na	306	732	na	na	<DL
Jun-01	**BPC5**	6.19	na	0.29	<.01	<.2	<.01	<.01	na	323	760	na	na	0.02
Jul-01	**BPC5**	6.1	na	0.285	<.01	<.2	<.01	<.01	na	307	748	na	na	0.01
Aug-01	**BPC5**	6.2	na	0.301	<.01	<.1	<.01	<.01	na	296	740	na	na	<DL
Sep-01	**BPC5**	6.23	na	0.297	<.01	<.1	<.01	<.01	na	329	784	na	na	<DL
Oct-01	**BPC5**	2.7	na	0.208	<.01	<.2	<.01	0.011	na	230	588	na	na	<DL
Nov-01	**BPC5**													
Dec-01	**BPC5**	6.14	na	0.281	<.01	<.2	<.01	<.002	na	317	696	na	na	<DL
Jan-02	**BPC5**													
Feb-02	**BPC5**	6.56	na	0.316	<.01	<.2	<.01	<.001	na	324	696	na	na	<DL
Mar-02	**BPC5**	5.92	na	0.256	<.01	<.2	<.01	0.007	na	289	628	na	na	<DL
Apr-02	**BPC5**	3.53	na	0.15	<.01	<.2	<.01	<.001	na	229	440	na	na	<DL
May-02	**BPC5**	3.01	na	0.144	<.01	<.2	<.01	0.005	na	185	468	na	na	<DL
Jun-02	**BPC5**	2.04	na	0.175	<.01	<.2	<.01	<.002	na	236	516	na	na	<DL
Jul-02	**BPC5**	2.68	na	0.174	<.01	<.2	<.01	<.002	na	221	480	na	na	<DL
Aug-02	**BPC5**	5.27	na	0.297	<.01	<.2	<.01	<.002	na	329	680	na	na	<DL
Sep-02	**BPC5**	1.16	na	0.121	<.01	<.1	<.01	<.002	na	323	684	na	na	<DL
	samples analyzed	89	na	89	89	89	89	89	na	89	89	na	na	89
	detects	89	na	89	0	1	1	32	na	89	89	na	na	45
	% detects	100	na	100	0	1	1	36	na	100	100	na	na	51
	min	1.16	na	0.121	-	0.4	0.01	0.002	na	144	440	na	na	0.01
	max	7.64	na	0.67	-	0.4	0.01	0.28	na	378	1216	na	na	0.12
	mean	5.62	na	0.3	-	-	-	0.05	na	307	732	na	na	0.04

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F mg/L	Cl mg/L	NO_3-N mg/L	SO_4 mg/L	Hg* mg/L	La* mg/L	Sc* mg/L	Zr* mg/L	IDC* mg/L	DOC* mg/L	TDC* mg/L	Hardness* mg/L	NO2-N* mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC5**	na	125	0.4	130	<DL	<2	<3	NA	79.4	150	230	576	<DL
Apr-94	**BPC5**	na	156	0.54	113	<.05	<.002	<.003	<.01	76.8	131	207	544	<.01
May-94	**BPC5**	na	137	0.46	101	<0.05	<2	<.3	<.01	72	137	209	547	<0.01
Jun-94	**BPC5**	na	181	0.51	149	<0.05	<2	<.3	<.01	76.6	128	205	397	<0.01
Jul-94	**BPC5**	na	125	0.42	122	<DL	<.005	<.005	<.01	8	12.4	20.4	554	<DL
Aug-94	**BPC5**	na	123	0.35	127	<DL	<.002	<.003	<.01	89.3	16.1	105	544	<DL
Sep-94	**BPC5**	na	113	0.34	127	<DL	<.002	<.003	NA	95.3	23.5	119	538	<DL
Oct-94	**BPC5**	na	110	0.36	133	<DL	<.002	<.003	NA	88.1	22.4	110.5	497	<DL
Nov-94	**BPC5**	na	109	0.28	130	<DL	<.002	<.003	<.01	85.6	7	92.6	482	<DL
Dec-94	**BPC5**													
Jan-95	**BPC5**	na	107	0.44	127	<DL	<.002	<.003	<.01	84.8	21.1	105.9	502	<DL
Feb-95	**BPC5**	na	101	0.54	118	<DL	<.005	<.005	<.01	79.5	0.7	80.2	490	<DL
Mar-95	**BPC5**	na	119	0.61	121	<DL	<.002	<.003	<.02	85.8	0.4	86.2	519	<DL
Apr-95	**BPC5**	na	127	0.58	119	<DL	<.002	<.003	<.02	82.1	0.6	82.7	513	<DL
May-95	**BPC5**	na	111	0.58	106	<DL	<.003	<.003	<.01	82.4	66.5	148.9	472	<DL
Jun-95	**BPC5**													
Jul-95	**BPC5**													
Aug-95	**BPC5**													
Sep-95	**BPC5**													
Oct-95	**BPC5**													
Nov-95	**BPC5**	na	92	0.28	130	<DL	<2	<3	<.01	71.4	29	100.4	484	<DL
Dec-95	**BPC5**	na	109	0.52	124	<DL	<.002	<.003	<.01	71.5	34.7	106.2	577	<DL
Jan-96	**BPC5**	na	124	0.71	124	<DL	<.002	<.003	<.01	69.1	43.8	112.9	570	<DL
Feb-96	**BPC5**	na	151	0.9	126	<DL	<.002	<.003	<.01	70.4	36.9	107.3	549	<DL
Mar-96	**BPC5**	na	475	1.2	119	0.31	<.002	<.003	<.01	47.3	42.1	89.4	490	<DL
Apr-96	**BPC5**	na	219	0.99	127	0.68	<.002	<.003	<.01	61.1	39	100	567	<DL
May-96	**BPC5**	na	214	0.87	109	0.22	<.002	<.003	<.01	56.7	45	101.7	544	<DL
Jun-96	**BPC5**	na	194	0.89	108	0.07	<.002	<.003	<.01	61.8	34.4	96.2	528	<DL
Jul-96	**BPC5**	na	168	1.03	103	<DL	<.002	<.003	<.01	56.8	41.1	97.9	507	<DL
Aug-96	**BPC5**	na	140	1.05	93	<DL	<.002	<.007	<.01	59	50.7	109.6	528	<DL
Sep-96	**BPC5**	na	95.9	0.83	72.4	0.14	<.002	<.003	<.01	40.5	43.7	84.3	305	<DL
Oct-96	**BPC5**	na	131	0.82	94.2	<DL	<.002	<.003	<.01	70.9	14.5	85.4	461	<DL
Nov-96	**BPC5**	na	132	0.59	102	0.09	<.002	<.003	<.01	65.5	24.3	89.7	460	<DL
Dec-96	**BPC5**	na	140	0.56	104	<DL	<.002	<.003	<.01	71.8	20.8	92.6	490	<DL
Jan-97	**BPC5**	na	126	1.34	95.2	<DL	<.002	<.003	<.01	65.5	21.1	86.6	570	<DL
Feb-97	**BPC5**	na	149	0.84	102	0.14	<.002	<.003	<.01	73.5	22	95.5	533	<DL
Mar-97	**BPC5**	na	163	0.89	103	<DL	<.002	<.003		74.1	17.2	91.3	557	<DL
Apr-97	**BPC5**	na	147	0.9	93	<DL	<.005	<.003		68.7	30.2	98.9	493	<DL
May-97	**BPC5**	na	119	0.84	92.4	0.08	<.005	<.003		58.9	30.9	89.8	497	<DL
Jun-97	**BPC5**	na	142	0.74	92.7	<DL	<.002	<.003		73.2	8.2	81.4	477	<DL
Jul-97	**BPC5**	na	148	0.64	97.7	<DL	<.002	<.003		68.5	61.7	130.2	540	<DL
Aug-97	**BPC5**	na	147	0.5	101	<DL	<.002	<.003		74.7	0.4	75.2	526	<DL
Sep-97	**BPC5**	na	151	0.42	107	<DL	<.002	<.003		68.7	20.5	89.2	499	<DL
Oct-97	**BPC5**	na	156	0.39	113	<DL	<.002	<.003		72.6	19	91.6	486	<DL
Nov-97	**BPC5**	na	143	0.33	111	<DL	<.002	<.003		66.2	26.9	93.1	506	<DL
Dec-97	**BPC5**	na	144	0.3	101	<DL	<.002	<.003		65.6	23	88.6	501	<DL
Jan-98	**BPC5**	na	131	0.36	114	<DL	<.002	<.003		60.4	25.6	86	629	<DL
Feb-98	**BPC5**	na	139	0.39	112	<DL	<.002	<.003		60.5	<DL	59.6	510	<DL
Mar-98	**BPC5**	na	141	0.45	108	<DL	<.002	<.003		58.4	2.9	61.2	522	<DL
Apr-98	**BPC5**	na	135	0.46	105	<DL	<.002	<.003		56.9	0.9	57.7	498	<DL
May-98	**BPC5**	na	124	0.42	100	0.17	<.002	<.003		59.3	32.7	92	462	<DL
Jun-98	**BPC5**	na	101	0.39	90.6	<DL	<.002	<.003		56.2	30.8	87	448	<DL
Jul-98	**BPC5**	na	120	0.31	112	<DL	<.002	<.003		55.8	27	82.7	465	<DL
Aug-98	**BPC5**	na	101	0.28	101	<DL	<.002	<.003		54.7	38.3	93	471	<DL
Sep-98	**BPC5**	na	100.57	0.27	96.7	<DL	<.002	<.003		54.6	20.7	75.3	472	<DL
Oct-98	**BPC5**	na	95.895	0.2	94.8	<DL	<.002	<.003		50.6	42.6	93.2	473	<DL
Nov-98	**BPC5**	na	98.75	0.18	102	0.24	<.002	<.003		51.1	54.9	106	481	<DL
Dec-98	**BPC5**													
Jan-99	**BPC5**	na	100	0.17	105.2	<DL	<.002	<.003		48.5	17.1	65.6	523	<DL
Feb-99	**BPC5**	na	102	0.25	100.7	<DL	<.002	<.003		81.6	12.3	93.9	495	<DL
Mar-99	**BPC5**	na	106	0.36	96.1	<DL	<.002	<.003		81.7	10	91.7	510	<DL
Apr-99	**BPC5**													
May-99	**BPC5**													
Jun-99	**BPC5**													
Jul-99	**BPC5**	na	104	0.29	95.1	<DL	<.002	<.003		69.7	15.9	85.6	456	<DL
Aug-99	**BPC5**	na	94	0.34	81.3	<DL	<.002	<.003		76.7	16.2	92.9	464	<DL
Sep-99	**BPC5**	na	94	0.19	89	0.05	<.002	<.003		73.9	31.2	105.1	463	<DL
Oct-99	**BPC5**	na	100	0.25	91.8	<DL	<.002	<.003		65.6	32	97.6	483	<DL
Nov-99	**BPC5**													
Dec-99	**BPC5**	na	122	0.29	104	<DL	<.002	<.003		48.6	16.8	65.4	377	<DL
Jan-00	**BPC5**	na	107	0.19	106	<DL	<.002	<.003		72.6	18.2	90.8	480	<DL
Feb-00	**BPC5**	na	77	0.41	87.3	<DL	<.002	<.003		55.6	23.4	78.9	409	<DL
Mar-00	**BPC5**	na	151	0.19	106	<DL	<.002	<.003		67.5	27.6	95.1	555	<DL
Apr-00	**BPC5**	na	135	0.12	79.3	<DL	<.002	<.003		37	14.3	51.3	361	<DL
May-00	**BPC5**	na	161	0.27	89.4	<DL	<.002	<.003		62.7	22	84.7	501	<DL
Jun-00	**BPC5**	na	148	0.27	83.4	<DL	<.002	<.003		57.8	20	77.8	439	<DL
Jul-00	**BPC5**	na	151	0.29	87	<DL	<.002	<.003		68.9	23.3	92.2	477	<DL
Aug-00	**BPC5**	na	143	0.22	88.1	<DL	<.002	<.003		69.5	19.8	89.3	466	<DL
Sep-00	**BPC5**	na	166	0.28	120	<DL	<.002	<.003		55.3	17.2	72.5	370	<DL
Oct-00	**BPC5**	na	127	0.11	89.2	<DL	<.002	<.003		72.8	18.7	91.5	471	<DL
Nov-00	**BPC5**	na	124	0.15	92.8	<DL	<.002	<.003		77.6	12.2	89.8	496	<DL
Dec-00	**BPC5**													
Jan-01	**BPC5**	na	122	0.15	97.4	<DL	<.002	<.003		77.3	8.9	86.2	490	<DL
Feb-01	**BPC5**	na	128	0.22	91.4	<DL	<.002	<.003		70.5	12.9	83.5	476	<DL
Mar-01	**BPC5**	na	143	0.28	91.6	<DL	<.002	<.003		74.2	15.9	90	527	<DL
Apr-01	**BPC5**	na	121	0.21	78.1	<DL		<.003		49.7	27.6	77.3	335	<DL
May-01	**BPC5**	na	140	0.44	85.2	0.19		<.003		74.3	37.1	111.4	513	<DL
Jun-01	**BPC5**	na	147	0.22	87.4	0.1		<.003		77.6	35.8	113.4	517	<DL
Jul-01	**BPC5**	na	146	0.24	89	<DL		<.003		78.3	1.8	80.1	503	<DL
Aug-01	**BPC5**	na	153	0.26	90.6	0.14		<.003		76.6	2.2	78.8	518	<DL
Sep-01	**BPC5**	na	148	0.2	90.4	<DL		<.003		75.4	2.1	77.4	524	<DL
Oct-01	**BPC5**	na	131	0.12	76	<DL		<.003		57.9	3.3	61.3	386	<DL
Nov-01	**BPC5**													
Dec-01	**BPC5**	na	129	0.23	92.6	0.07		<.003		75.5	0.3	75.7	488	<DL
Jan-02	**BPC5**													
Feb-02	**BPC5**	na	134	0.2	95.2	<DL		<.003		78.9	3.6	82.6	530	<DL
Mar-02	**BPC5**	na	107	0.17	86.8	0.06		<.003		67.7	2.8	70.5	460	<DL
Apr-02	**BPC5**	na	92	0.18	57	<DL		<.003		37.2	<DL	37.2	274	<DL
May-02	**BPC5**	na	111	0.17	65.3	<DL		<.003		35.5	2.3	37.8	285	<DL
Jun-02	**BPC5**	na	118	0.26	72.9	<DL		<.003		44.7	1.4	46.1	338	<DL
Jul-02	**BPC5**	na	110	0.18	63.7	<DL		<.003		43.9	1	44.9	311	<DL
Aug-02	**BPC5**	na	126	0.21	87	<DL		<.003		73.6	4.4	78	499	<DL
Sep-02	**BPC5**	na	124	0.22	88.7	0.07		<.003		78.7	8.3	86.9	207	<DL
	samples analyzed	na	89	89	89	89	73	89	27	89	89	89	89	89
	detects	na	89	89	89	17	0	0	0	89	87	89	89	0
	% detects	na	100	100	100	19	0	0	0	100	98	100	100	0
	min	na	77	0.11	57	0.05	-	-	-	8	0.3	20.4	207	-
	max	na	475	1.34	149	0.68	-	-	-	95.3	150	230	629	-
	mean	na	134	0.4	101	0.2	-	-	-	66	27	92	481	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC6**														
Apr-94	**BPC6**														
May-94	**BPC6**														
Jun-94	**BPC6**														
Jul-94	**BPC6**														
Aug-94	**BPC6**														
Sep-94	**BPC6**														
Oct-94	**BPC6**														
Nov-94	**BPC6**														
Dec-94	**BPC6**														
Jan-95	**BPC6**														
Feb-95	**BPC6**														
Mar-95	**BPC6**														
Apr-95	**BPC6**														
May-95	**BPC6**														
Jun-95	**BPC6**														
Jul-95	**BPC6**														
Aug-95	**BPC6**														
Sep-95	**BPC6**														
Oct-95	**BPC6**														
Nov-95	**BPC6**	7.96	2825	1.5	5		<.02	<.1	0.09	0.07	<1	102	<.01	<.01	<.01
Dec-95	**BPC6**	8.42	3368	0.4	0		<.01	<.1	0.11	0.08	<.001	135	<.01	<.01	<.01
Jan-96	**BPC6**	8.17	3927	0.0	10		<.02	<.1	0.05	0.07	0.002	116	<.01	<.01	<.01
Feb-96	**BPC6**	8.15	4109	0.5	6		0.04	<.1	0.08	0.07	<.002	118	<.01	<.01	<.01
Mar-96	**BPC6**	8.22	4562	7.0	10		0.08	<.1	0.03	0.07	<.001	106	<.01	<.01	<.01
Apr-96	**BPC6**	8.05	2808	12.7	11		0.05	<.1	0.07	0.07	0.001	89.1	<.01	<.01	<.01
May-96	**BPC6**	8.32	1241	21.7	4		0.04	<.1	0.09	0.07	<.001	88.2	<.01	<.01	<.01
Jun-96	**BPC6**	8.44	1690	23.0	6		0.02	<.1	0.12	0.07	<.001	105	<.01	<.01	<.01
Jul-96	**BPC6**	7.87	1210	21.7	187		<.02	<.1	0.1	0.06	<.001	78.1	<.01	<.01	<.01
Aug-96	**BPC6**	8.34	1140	23.8	3		<.01	<.1	0.12	0.06	<.001	75	<.01	<.01	<.01
Sep-96	**BPC6**	7.91	528	16.9	38		<.03	<.1	0.06	0.04	<.001	42.6	<.01	<.01	<.01
Oct-96	**BPC6**	7.79	618	11.4	40		<.03	<.1	0.07	0.04	<.001	56.6	<.01	<.01	<.01
Nov-96	**BPC6**	7.84	704	3.2	53		<.02	<.1	0.09	0.07	<.001	109	<.01	<.01	<.01
Dec-96	**BPC6**	7.45	669	3.3	497		<.01	<.1	<.02	0.04	<.001	64.6	0.01	<.01	<.01
Jan-97	**BPC6**	7.96	1690				0.06	<.1	0.07	0.08	<.001	109	<.01	<.01	<.01
Feb-97	**BPC6**	7.97	577	2.3	176		<.02	<.2	0.05	0.05	<.001	72.1	<.01	<.01	<.01
Mar-97	**BPC6**	8.82	999	11.6	41		<.02	<.1	0.08	0.06	<.001	94.8	<.01	<.01	<.01
Apr-97	**BPC6**	8.36	1200	14.1	5		0.03	<.1	0.07	0.07	<.001	93.3	<.01	<.01	<.01
May-97	**BPC6**	8.25	1085	13.4	41		<.04	<.2	0.12	0.11	<.002	136	<.01	<.01	<.01
Jun-97	**BPC6**	7.96	1150	17.4	51		<.02	<.1	0.06	0.07	<.002	84.9	<.01	<.01	<.01
Jul-97	**BPC6**	8.14	1190	23.2	8		<.02	<.1	0.06	0.06	<.001	77.4	<.01	<.01	<.01
Aug-97	**BPC6**	8.03	574	19.5	143		<.02	<.1	0.08	0.04	<.001	56.8	<.01	<.01	<.01
Sep-97	**BPC6**	8.07	898	14.3	25		0.06	<.2	0.11	0.07	<.001	82.3	<.01	<.01	<.01
Oct-97	**BPC6**	8.16	612	10.2	16		0.04	<.2	0.06	0.07	<DL	94.2	<.01	<.01	<.01
Nov-97	**BPC6**	7.51	1685	2.4	9		<.02	<.3	0.08	0.08	<.002	99.5	<.01	<.01	<.01
Dec-97	**BPC6**	8.06	1470	1.5	22		0.03	<.3	0.07	0.06	<.002	88	<.01	<.01	<.01
Jan-98	**BPC6**	8.16	1661	2.4	1000		<.02	<.1	0.06	0.08	<.001	74	<.01	<.01	<.01
Feb-98	**BPC6**	8.66	1277	9.2	28		0.02	<.2	0.06	0.05	<.001	83.3	<.01	<.01	<.01
Mar-98	**BPC6**	8.33	1287	12.5	35		<.02	<.1	0.05	0.05	<.001	82.8	<.01	<.01	<.01
Apr-98	**BPC6**	8.21	829	15.7	88		<.02	<.1	0.05	0.04	<.001	65.9	<.01	<.01	<.01
May-98	**BPC6**	8.19	1092	17.9	12		<.02	<.1	0.07	0.06	<.001	83.3	<.01	<.01	<.01
Jun-98	**BPC6**	7.79	893	25.4	12		<.02	<.1	0.09	0.06	<.001	69.8	<.01	<.01	<.01
Jul-98	**BPC6**	8.25	546	23.3	26		0.03	<.1	0.05	0.04	<.001	53.5	<.02	<.01	<.01
Aug-98	**BPC6**	8.50	705	27.6	52		0.03	<.1	0.09	0.04	<.001	50.3	<.02	<.01	<.01
Sep-98	**BPC6**	8.30	453	22.6	194		0.04	<.1	0.06	<DL	<.003	42.5	<.01	<.01	<.01
Oct-98	**BPC6**	8.42	822	16.0	15		0.05	<.1	0.09	0.05	<.001	74.9	<.01	<.01	<.01
Nov-98	**BPC6**	8.27	905	7.0	17		0.04	<.1	0.09	0.06	<.001	84.8	<.01	<.01	<.01
Dec-98	**BPC6**														
Jan-99	**BPC6**	7.60	2328	2.1	21		<.01	<.1	0.06	0.09	<.001	121	<.01	<.01	<.01
Feb-99	**BPC6**	7.75	1782	4.4	47		<.02	<.1	0.06	0.08	<.002	99.5	<.01	<.01	<.01
Mar-99	**BPC6**	8.69	1552	10.9			<.01	<.1	0.06	0.07	<.002	98	<.01	<.01	<.01
Apr-99	**BPC6**														
May-99	**BPC6**														
Jun-99	**BPC6**														
Jul-99	**BPC6**	8.18	1083	24.4	9		<.02	<.1	0.09	0.07	<.001	78.3	<.01	<.01	<.01
Aug-99	**BPC6**	7.87	1158	24.7	134		<.02	<.1	0.12	0.09	<.003	112	<.01	<.01	<.01
Sep-99	**BPC6**	7.64	518	16.0	52		<.02	<.1	0.06	<DL	<.001	45.7	<.01	<.01	<.01
Oct-99	**BPC6**	7.80		10.0			<.02	<.1	0.13	0.07	<.002	93	<.01	<.01	<.01
Nov-99	**BPC6**														
Dec-99	**BPC6**	8.18	953	6.2	0		<.02	<.2	0.08	0.05	<.001	81.4	<.01	<.01	<.01
Jan-00	**BPC6**	7.87	1557	1.9	38		<.02	<.2	0.06	0.06	<.001	89	<.01	<.01	<.01
Feb-00	**BPC6**	7.67	2333	3.3	420		<DL	<.2	0.07	0.069	<.001	97.2	<.01	<.01	<.01
Mar-00	**BPC6**	8.02	2122	7.5	8		<.01	<.1	0.07	0.073	<.001	111	<.02	<.01	<.01
Apr-00	**BPC6**	8.02	1140	12.2	51		<.02	<.1	0.07	0.045	<.001	73.9	<.01	<.01	<.01
May-00	**BPC6**	8.12	951	17.3	65		<.02	<.1	0.06	0.063	<.001	72.1	<.01	<.01	<.01
Jun-00	**BPC6**	8.01	741	23.3	140		<.01	<.1	0.07	0.042	<.001	55.4	<.01	<.01	<.01
Jul-00	**BPC6**	7.98	1025	20.9	10		<.01	<.1	0.08	0.059	<.001	82	<.01	<.01	<.01
Aug-00	**BPC6**	8.09	931	21.8	16		<.01	<.2	0.091	0.057	<.001	62.1	<.01	<.01	<.01
Sep-00	**BPC6**	7.84	800	14.4	26		<.1	<.2	0.09	0.029	<.001	53.5	<.01	<.01	<.01
Oct-00	**BPC6**	7.54	1025	16.0	5		<.1	<.2	0.1	0.063	<.001	84.1	<.01	<.01	<.01
Nov-00	**BPC6**	7.15	1373	0.3	80		<.02	<.05	0.102	0.063	<.001	96.8	<.01	<.01	<.01
Dec-00	**BPC6**														
Jan-01	**BPC6**														
Feb-01	**BPC6**	7.11	1491	1.7	100		<.3	<.1	0.05	0.046	<.001	72.7	<.01	<.01	<.01
Mar-01	**BPC6**	7.37	1739	5.7	14		<.3	<.1	0.08	0.06	<.001	96.2	<.01	<.01	<.01
Apr-01	**BPC6**	8.21	1242	16.8	71		<.02	<.1	0.04	0.025	<.001	49.9	<.01	<.01	<.01
May-01	**BPC6**	7.40	1493	13.4	14		<DL	<.1	0.08	0.061	<.001	79.1	<.01	<.01	<.01
Jun-01	**BPC6**	7.68	1393	18.8	18		<DL	<.1	0.05	0.06	<.001	76.7	<.01	<.01	<.01
Jul-01	**BPC6**	7.56	992	25.8	33		<DL	<.1	0.06	0.041	<.001	52.2	<.01	<.01	<.01
Aug-01	**BPC6**	6.88	920	20.1	9		<DL	<.2	0.07	0.049	<.001	57.3	<.01	<.01	<.01
Sep-01	**BPC6**	7.10	867	13.9	19		<.01	<.2	0.06	0.047	<.001	62.2	<.01	<.01	<.01
Oct-01	**BPC6**	7.82	858	8.0	29		<.02	<.2	0.08	0.037	<.003	60.6	<.01	<.01	<.04
Nov-01	**BPC6**														
Dec-01	**BPC6**	8.17	974	1.9	9		<.02	<.2	0.08	0.05	<.003	77.7	<.01	<.01	<.04
Jan-02	**BPC6**														
Feb-02	**BPC6**	6.95	1931	1.4	8		<.02	<.1	0.08	0.081	<.001	109	<.01	<.01	<.01
Mar-02	**BPC6**	7.29	1775	5.1	40		<.02	<.1	0.04	0.063	<.001	91.8	<.01	<.01	<.01
Apr-02	**BPC6**	8.11	1529	11.8	52		<.1	<.1	0.05	0.03	<.001	43.7	<.01	<.01	<.01
May-02	**BPC6**	6.90	1206	15.0	48		<.1	<.1	0.05	0.023	<.001	29.2	<.01	<.01	<.01
Jun-02	**BPC6**	7.54	671	20.2	166		<.02	<.1	0.03	0.022	<.002	25.2	<.01	<.01	<.01
Jul-02	**BPC6**	8.43	1022	28.7	16		<.02	<.1	0.03	0.03	<.002	33.1	<.01	<.01	<.01
Aug-02	**BPC6**	7.71	727	23.5	43		<.02	<.1	0.02	0.042	<.002	51.3	<.01	<.01	<.01
Sep-02	**BPC6**	7.07	860	19.2	7		<.01	<.1	0.06	0.026	<.001	23.1	<.01	<.01	<.01
	samples analyzed						74	74	74	74	74	74	74	74	74
	detects						16	0	73	72	2	74	1	0	0
	% detects						22	0	99	97	3	100	1	0	0
	min	6.88	453	0.0	0		0.02	-	0.02	0.022	0.001	23.1	0.01	-	-
	max	8.82	4562	28.7	1000		0.08	-	0.13	0.11	0.002	136	0.01	-	-
	mean	7.93	1343	13	66		0.04	-	0.07	0.06	0.002	78.9	-	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC6**														
Apr-94	**BPC6**														
May-94	**BPC6**														
Jun-94	**BPC6**														
Jul-94	**BPC6**														
Aug-94	**BPC6**														
Sep-94	**BPC6**														
Oct-94	**BPC6**														
Nov-94	**BPC6**														
Dec-94	**BPC6**														
Jan-95	**BPC6**														
Feb-95	**BPC6**														
Mar-95	**BPC6**														
Apr-95	**BPC6**														
May-95	**BPC6**														
Jun-95	**BPC6**														
Jul-95	**BPC6**														
Aug-95	**BPC6**														
Sep-95	**BPC6**														
Oct-95	**BPC6**														
Nov-95	**BPC6**	<DL	<.01	2	<.01	48.4	0.07	<.02	151	<.03	0.03	<.05	na	<.2	<.2
Dec-95	**BPC6**	<.01	<.01	<1	<.01	65.0	0.09	<.02	179	<.03	0.02	<.05	na	<.2	<.1
Jan-96	**BPC6**	<.01	<.01	<1	0.01	53.6	0.08	<.02	156	<.03	0.02	<.05	na	<.2	<.1
Feb-96	**BPC6**	<.01	0.13	4	<.01	55.3	0.07	<.02	177	<.03	0.03	<.08	na	<.1	<.1
Mar-96	**BPC6**	<.01	0.11	4	<.01	51.2	0.06	<.02	273	<.03	0.01	<.04	na	<.1	<.1
Apr-96	**BPC6**	<.01	<.01	<1	<.01	40.7	0.02	<.02	264	<.03	0.08	<.05	na	<.1	<.2
May-96	**BPC6**	<DL	<DL	<1	<.01	43.6	0.01	<.02	145	<.03	0.03	<.05	na	<.2	<.1
Jun-96	**BPC6**	0.06	<.01	<1	<.01	48.9	0.02	<.02	114	<.03	0.02	<.05	na	<.2	<.2
Jul-96	**BPC6**	0.08	<.01	2	<.01	34.5	<.01	<.02	76.7	<.03	<DL	<.04	na	<.2	<.2
Aug-96	**BPC6**	0.03	<DL	2	<.03	41.1	0.01	<.02	76	<.03	0.07	<.05	na	<.2	<.2
Sep-96	**BPC6**	<.01	<.01	6	<.01	22.6	0.02	<.02	47.4	<.03	0.06	<.05	na	<.2	<.2
Oct-96	**BPC6**	0.06	<.01	3	<.01	28.0	0.01	<.02	77.6	<.03	0.08	<.05	na	<.2	<.2
Nov-96	**BPC6**	0.04	<.01	4	<.01	50.0	0.05	<.02	90.8	<.03	0.05	<.04	na	<.2	<.2
Dec-96	**BPC6**	0.03	<.03	3	<.01	27.9	0.01	<.02	137	<.03	0.13	<.05	na	<.2	<.2
Jan-97	**BPC6**	0.07	<.1	5	<.01	48.0	0.03	<.02	253	<.03	0.07	<.05	na	<.2	<.2
Feb-97	**BPC6**	0.07	<.03	2	<.01	32.7	<.01	<.02	123	<.03	0.11	<.05	na	<.2	<.2
Mar-97	**BPC6**	<DL	<.01	2	<.01	46.2	<.01	<.02	133	<.03	0.03	<.05	na	<.2	<.2
Apr-97	**BPC6**	<.01	0.15	2	<.01	50.8	0.03	<.01	145	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC6**	<.02	0.49	<1	<.01	56.7	0.16	<.02	162	<.03	0.04	<.05	na	<.2	<.2
Jun-97	**BPC6**	<.02	<.01	<1	<.01	45.9	0.09	<.02	155	<.03	0.03	<.05	na	<.2	<.1
Jul-97	**BPC6**	<.01	<.01	3	<.01	44.4	0.02	<.01	126	<.03	<DL	<.05	na	<.2	<.2
Aug-97	**BPC6**	<.01	<DL	<1	<.01	21.8	<.01	<.02	54.6	<.03	<DL	<.05	na	<.2	<.2
Sep-97	**BPC6**	<DL	0.05	5	<.01	37.8	<.01	<.02	109	<.03	<DL	<.05	na	<.2	<.1
Oct-97	**BPC6**	<.01	<.01	4	0.01	43.0	<.01	<.02	86.5	<.03	<DL	<.05	na	<.2	<.1
Nov-97	**BPC6**	<.02	<.01	3	<.01	46.3	0.02	<.02	192	<.03	0.08	<.05	na	<.2	<.2
Dec-97	**BPC6**	<.02	<.01	4	<.01	39.3	0.05	0.09	122	<.03	0.03	<.05	na	<.2	<.2
Jan-98	**BPC6**	<.01	<.01	<1	0.01	32.7	0.21	<.02	190	<.03	0.03	<.05	na	<.1	<.2
Feb-98	**BPC6**	<.01	<.02	3	0.01	38.3	0.02	<.02	157	<.03	0.02	<.05	na	<.2	<.1
Mar-98	**BPC6**	<.01	<.01	4	0.01	38.4	0.01	<.01	128	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC6**	<.01	<.01	<1	<.01	32.8	<.01	<.02	98	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC6**	<.01	<.01	3	0.01	40.1	0.03	<.02	107	<.03	<DL	<.05	na	<.1	<.2
Jun-98	**BPC6**	<.01	<.01	2	<.01	33.7	0.01	<.02	78.1	<.03	0.03	<.05	na	<.1	<.2
Jul-98	**BPC6**	<.03	<.01	<2	<.02	25.5	<.01	<.02	41.4	<.03	0.06	<.05	na	<.3	<.2
Aug-98	**BPC6**	<.03	<DL	<2	<.02	24.5	<.01	<.02	66	<.03	0.04	<.05	na	<.3	<.2
Sep-98	**BPC6**	<.01	<DL	3	<.01	16.9	<.01	0.03	27.1	<.03	0.05	<.07	na	<.2	<.1
Oct-98	**BPC6**	<.01	0.04	4	<.01	35.4	<.01	<.02	60.5	<.03	0.03	<.05	na	<.2	<.2
Nov-98	**BPC6**	<.01	<DL	4	<.01	38.3	0.02	<.02	81.6	<.03	0.04	<.05	na	<.2	<.2
Dec-98	**BPC6**														
Jan-99	**BPC6**	<.01	<.01	5	<.01	48.9	0.1	<.02	346	<.03	<DL	<.05	na	<.2	<.1
Feb-99	**BPC6**	<.01	<.01	4	<.01	47.4	0.03	<.02	254	<.03	<DL	<.03	na	<.2	<.2
Mar-99	**BPC6**	<.01	<.01	3	<.01	49.5	<.01	<.02	172	<.03	<DL	<.03	na	<.2	<.2
Apr-99	**BPC6**														
May-99	**BPC6**														
Jun-99	**BPC6**														
Jul-99	**BPC6**	<.01	<.01	4	<.01	43.4	<.01	<.02	113	<.03	0.07	<.05	na	<.1	<.1
Aug-99	**BPC6**	<.01	<.01	10	<.015	61.9	<.01	<.02	72.7	<.02	<DL	<.05	na	<.2	<.2
Sep-99	**BPC6**	<.01	<.01	2	<.05	22.3	<.01	<.02	37.4	<.03	0.12	<.05	na	<.3	<.2
Oct-99	**BPC6**	<.01	<.01	6	0.01	48.2	0.02	<.02	91.7	<.03	0.07	<.05	na	<.3	<.2
Nov-99	**BPC6**														
Dec-99	**BPC6**	<.01	<.01	5	0.01	37.2	<.01	<.02	73.2	<.03	0.21	<.05	na	<.1	<.2
Jan-00	**BPC6**	<.01	<.01	3	<.01	39.5	<.01	<.02	168	<.1	0.04	<.05	na	<.2	<.2
Feb-00	**BPC6**	<.01	<.01	5	0.01	40.8	0.003	<.02	313	<.01	0.07	<.02	na	<.05	<.05
Mar-00	**BPC6**	0.01	0.02	3	0.01	54.8	0.007	<.01	274	0.01	<DL	<.03	na	<.1	<.1
Apr-00	**BPC6**	<.01	0.02	3	<.01	36.7	0.012	<.01	126	<.01	<DL	<.02	na	<.1	<.1
May-00	**BPC6**	<.01	0.05	4	<.01	32.4	0.007	<.01	93.6	<.01	0.02	<.02	na	<.1	<.1
Jun-00	**BPC6**	0.004	0.01	3	<DL	25.3	0.004	<.01	72	<.01	<DL	<.03	na	<.1	<.1
Jul-00	**BPC6**	<.01	<.01	4	0.01	39.9	0.002	<.02	80.6	<.01	0.06	<.02	na	<.1	<.1
Aug-00	**BPC6**	<DL	0.01	5	0.01	34.5	0.002	<.03	89.9	<.01	<DL	<.03	na	<.1	<.1
Sep-00	**BPC6**	<.01	0.02	5	<.01	35.9	0.01	<.02	68.5	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC6**	<.01	<.01	<1	<.01	40.5	0.002	<.02	74	<.01	<DL	<.03	na	<.2	<.2
Nov-00	**BPC6**	0.005	<.01	<1	<.01	46.7	<.001	<.01	145	<.01	<DL	<.02	na	<.1	<.1
Dec-00	**BPC6**														
Jan-01	**BPC6**														
Feb-01	**BPC6**	<.003	0.02	5	<.01	30.9	0.008	<.02	204	<.01	0.04	<.05	na	<.1	<.1
Mar-01	**BPC6**	0.003	<.01	5	<.01	49.8	<.001	<.02	213	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC6**	<.01	<.01	5	<.01	29.8	<.002	<.02	138	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC6**	<.01	<.01	3	0.01	42.0	<.002	<.02	194	<.01	<DL	<.05	na	<.1	<.1
Jun-01	**BPC6**	<.01	<.01	4	0.01	38.5	<.002	<.02	167	<.01	<DL	<.05	na	<.1	<.1
Jul-01	**BPC6**	<.01	<.01	4	<.01	26.7	<.002	<.02	123	<.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC6**	<.01	0.02	4	<.01	28.1	<.004	<.01	97.8	<.01	<DL	<.05	na	<.1	<.1
Sep-01	**BPC6**	<.01	<.01	4	<.01	28.9	<.004	<.01	89.5	<.01	<DL	<.05	na	<.1	<.1
Oct-01	**BPC6**	0.003	0.01	4	<.01	29.2	0.01	<.01	78.2	<.01	0.02	<.02	na	<.1	<.2
Nov-01	**BPC6**														
Dec-01	**BPC6**	<.003	<.01	<1	<.01	34.0	0.026	<.01	102	<.01	<DL	<.02	na	<.1	<.2
Jan-02	**BPC6**														
Feb-02	**BPC6**	0.01	0.01	4	0.01	46.7	0.056	<.05	251	<.01	0.02	<.03	na	<.1	<.1
Mar-02	**BPC6**	0.005	<.01	6	<.01	40.3	0.009	0.07	263	<.01	0.02	<.03	na	<.1	<.1
Apr-02	**BPC6**	<.01	<.01	4	0.01	22.5	0.015	<.01	140	<.01	0.09	<.02	na	<.1	<.1
May-02	**BPC6**	0.01	<.01	3	<.01	17.6	0.017	<.01	108	<.01	0.01	<.02	na	<.1	<.1
Jun-02	**BPC6**	<.01	<.01	<1	<.01	16.2	0.011	<.01	73	<.01	0.03	<.05	na	<.1	<.1
Jul-02	**BPC6**	<.01	<.01	3	<.01	19.1	0.007	<.01	70.9	<.01	0.03	<.05	na	<.1	<.1
Aug-02	**BPC6**	<.01	0.02	4	<.01	23.2	0.006	<.01	69.5	<.01	0.04	<.05	na	<.1	<.1
Sep-02	**BPC6**	<.01	0.02	<1	<.01	12.0	0.008	<.01	53.2	<.01	<DL	<.05	na	<.1	<.1
	samples analyzed	74	74	74	74	74	74	74	74	74	74	74	na	74	74
	detects	16	18	57	16	74	49	3	74	1	47	0	na	0	0
	% detects	22	24	77	22	100	66	4	100	1	64	0	na	0	0
	min	0.003	0.01	2	0.01	12.0	0.002	0.03	27.1	0.01	0.01	-	-	-	-
	max	0.08	0.49	10	0.01	65.0	0.21	0.09	346	0.01	0.21	-	-	-	-
	mean	0.03	0.1	4	0.01	37.9	0.03	0.06	132	-	0.05	-	-	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC6**													
Apr-94	**BPC6**													
May-94	**BPC6**													
Jun-94	**BPC6**													
Jul-94	**BPC6**													
Aug-94	**BPC6**													
Sep-94	**BPC6**													
Oct-94	**BPC6**													
Nov-94	**BPC6**													
Dec-94	**BPC6**													
Jan-95	**BPC6**													
Feb-95	**BPC6**													
Mar-95	**BPC6**													
Apr-95	**BPC6**													
May-95	**BPC6**													
Jun-95	**BPC6**													
Jul-95	**BPC6**													
Aug-95	**BPC6**													
Sep-95	**BPC6**													
Oct-95	**BPC6**													
Nov-95	**BPC6**	3.67	na	0.17	<.01	<.4	<.01	0.01	na	238	996	na	na	0.08
Dec-95	**BPC6**	3.74	na	0.22	<.01	<.3	<.01	<.01	na	272	1156	na	na	0.03
Jan-96	**BPC6**	3.19	na	0.18	<.01	<.6	<.01	0.02	na	239	1108	na	na	0.11
Feb-96	**BPC6**	3.12	na	0.19	<.01	<.3	<.01	<.01	na	260	1140	na	na	0.08
Mar-96	**BPC6**	2.21	na	0.18	<.01	<.3	<.01	0.01	na	229	1460	na	na	0.08
Apr-96	**BPC6**	2.63	na	0.18	<.01	<.3	<.01	<.01	na	183	1324	na	na	0.02
May-96	**BPC6**	3.06	na	0.16	<.01	<1	<.01	<.01	na	232	908	na	na	0.06
Jun-96	**BPC6**	4.22	na	0.17	<.01	<.6	<.01	0.2	na	272	900	na	na	0.04
Jul-96	**BPC6**	4.06	na	0.12	<.01	<.2	<.01	0.05	na	203	640	na	na	0.14
Aug-96	**BPC6**	1.51	na	0.15	<.01	<.3	<.01	0.02	na	184	572	na	na	0.02
Sep-96	**BPC6**	1.99	na	0.11	<.01	<.3	<.01	0.02	na	128	448	na	na	0.08
Oct-96	**BPC6**	2.6	na	0.13	<.01	<.3	<.01	0.04	na	157	528	na	na	0.07
Nov-96	**BPC6**	4.85	na	0.19	<.01	<.3	<.01	0.01	na	271	904	na	na	0.1
Dec-96	**BPC6**	2.33	na	0.12	<.01	<.3	<.01	0.01	na	143	752	na	na	0.12
Jan-97	**BPC6**	3.76	na	0.19	<.01	<.3	<.01	0.03	na	212	1132	na	na	<DL
Feb-97	**BPC6**	3.37	na	0.12	<.01	<.3	<.01	0.04	na	172	712	na	na	0.08
Mar-97	**BPC6**	2.21	na	0.15	<.01	<.3	<.01	0.01	na	203	772	na	na	0.12
Apr-97	**BPC6**	1.09	na	0.15	<.01	<0	<.01	0.01	na	258	912	na	na	0.02
May-97	**BPC6**	1.59	na	0.28	<.01	<.3	<.01	0.07	na	240	992	na	na	0.16
Jun-97	**BPC6**	4.03	na	0.16	<.01	<.3	<.01	<.01	na	234	1040	na	na	0.17
Jul-97	**BPC6**	3.11	na	0.15	<.01	<.3	<.01	<.01	na	202	880	na	na	0.02
Aug-97	**BPC6**	3.9	na	0.08	<.01	<.3	<.01	<.01	na	149	444	na	na	<DL
Sep-97	**BPC6**	2.19	na	0.15	<.01	<.4	<.01	0.01	na	272	1092	na	na	0.07
Oct-97	**BPC6**	2.62	na	0.18	<.01	<.4	<.01	0.01	na	188	860	na	na	0.04
Nov-97	**BPC6**	2.56	na	0.21	<.01	<.3	<.01	<.01	na	230	1024	na	na	0.07
Dec-97	**BPC6**	2.27	na	0.18	<.01	<.3	<.01	0.08	na	186	752	na	na	0.1
Jan-98	**BPC6**	2.35	na	0.14	<.01	<.3	<.01	0.01	na	185	1084	na	na	<DL
Feb-98	**BPC6**	1.86	na	0.14	<.01	<.2	<.01	<.01	na	186	804	na	na	0.02
Mar-98	**BPC6**	2.28	na	0.13	<.01	<.2	<.01	<.01	na	191	700	na	na	0.08
Apr-98	**BPC6**	1.37	na	0.11	<.01	<.3	<.01	<.01	na	174	632	na	na	<DL
May-98	**BPC6**	2.79	na	0.15	<.01	<.3	<.01	<.01	na	235	792	na	na	0.15
Jun-98	**BPC6**	2.49	na	0.12	<.01	<.3	<.01	0.04	na	225	596	na	na	0.05
Jul-98	**BPC6**	1.76	na	0.11	<.01	<.3	<.01	<.01	na	154	420	na	na	<DL
Aug-98	**BPC6**	1.42	na	0.1	<.01	<.3	<.01	<.01	na	146	444	na	na	0.12
Sep-98	**BPC6**	1.85	na	0.07	<.01	<.3	<.01	<.01	na	105	296	na	na	0.03
Oct-98	**BPC6**	3.16	na	0.14	<.01	<.3	<.01	0.25	na	197	516	na	na	0.31
Nov-98	**BPC6**	2.9	na	0.14	<.01	<.3	<.01	0.11	na	232	592	na	na	0.05
Dec-98	**BPC6**													
Jan-99	**BPC6**	3.34	na	0.21	<.01	<.3	<.01	<.01	na	230	1320	na	na	0.24
Feb-99	**BPC6**	2.21	na	0.18	<.01	<.3	<.01	<.01	na	240	1124	na	na	0.1
Mar-99	**BPC6**	1.99	na	0.18	<.01	<.3	<.01	<.01	na	234	924	na	na	0.08
Apr-99	**BPC6**													
May-99	**BPC6**													
Jun-99	**BPC6**													
Jul-99	**BPC6**	1.34	na	0.15	<.01	<.2	<.01	0.01	na	220	792	na	na	0.08
Aug-99	**BPC6**	5.08	na	0.38	<.01	<.2	<.01	<.01	na	254	860	na	na	0.09
Sep-99	**BPC6**	2.04	na	0.13	<.01	<.3	<.01	<.01	na	119	392	na	na	0.04
Oct-99	**BPC6**	2.43	na	0.28	<.01	<.3	<.01	0.04	na	246	692	na	na	<DL
Nov-99	**BPC6**													
Dec-99	**BPC6**	2.16	na	0.29	<.01	<.5	<.01	0.02	na	203	564	na	na	0.04
Jan-00	**BPC6**	1.7	na	0.28	<.01	<.3	<.01	<.01	na	189	908	na	na	<DL
Feb-00	**BPC6**	2.46	na	0.273	<.01	<.1	<.01	0.014	na	164	1212	na	na	<DL
Mar-00	**BPC6**	1.39	na	0.383	<.01	<.1	<.01	0.017	na	210	1184	na	na	<DL
Apr-00	**BPC6**	2.52	na	0.157	<.01	<.1	<.01	0.024	na	184	748	na	na	0.06
May-00	**BPC6**	2.16	na	0.163	<.01	<.1	<.01	0.145	na	176	576	na	na	0.04
Jun-00	**BPC6**	2.33	na	0.136	<.01	<.1	<.01	0.003	na	157	464	na	na	0.04
Jul-00	**BPC6**	2.6	na	0.331	<.01	<.1	<.01	<.01	na	207	660	na	na	<DL
Aug-00	**BPC6**	1.41	na	0.223	<.01	<.3	<.01	<.005	na	163	604	na	na	0.07
Sep-00	**BPC6**	1.65	na	0.185	<.01	<.2	<.01	<.01	na	157	544	na	na	<DL
Oct-00	**BPC6**	1.9	na	0.286	<.01	<.2	<.01	<.01	na	204	596	na	na	0.04
Nov-00	**BPC6**	2.93	na	0.195	<.01	<.1	<.01	<.002	na	247	820	na	na	0.07
Dec-00	**BPC6**													
Jan-01	**BPC6**													
Feb-01	**BPC6**	2.28	na	0.118	<.01	<.1	<.01	<.01	na	147	836	na	na	0.12
Mar-01	**BPC6**	1.5	na	0.168	<.01	<.1	<.01	0.01	na	229	940	na	na	<DL
Apr-01	**BPC6**	1.01	na	0.098	<.01	<.1	<.01	<.005	na	86	936	na	na	0.08
May-01	**BPC6**	1.1	na	0.167	<.01	<.2	<.01	<.01	na	179	876	na	na	0.02
Jun-01	**BPC6**	1.3	na	0.15	<.01	<.2	<.01	<.01	na	176	820	na	na	0.03
Jul-01	**BPC6**	1.61	na	0.12	<.01	<.2	<.01	0.02	na	118	612	na	na	0.03
Aug-01	**BPC6**	1.12	na	0.125	<.01	<.1	<.01	<.01	na	145	564	na	na	0.02
Sep-01	**BPC6**	1.29	na	0.117	<.01	<.1	<.01	<.01	na	158	580	na	na	<DL
Oct-01	**BPC6**	2.63	na	0.1	<.01	<.2	<.01	0.027	na	156	504	na	na	<DL
Nov-01	**BPC6**													
Dec-01	**BPC6**	1.64	na	0.132	<.01	<.2	<.01	<.002	na	202	616	na	na	0.03
Jan-02	**BPC6**													
Feb-02	**BPC6**	1.68	na	0.208	<.01	<.2	<.01	0.007	na	231	1068	na	na	0.01
Mar-02	**BPC6**	2.27	na	0.158	<.01	<.2	<.01	0.007	na	202	1092	na	na	0.04
Apr-02	**BPC6**	0.89	na	0.085	<.01	<.2	<.01	<.001	na	149	588	na	na	<DL
May-02	**BPC6**	0.64	na	0.063	<.01	<.2	<.01	0.005	na	119	452	na	na	0.11
Jun-02	**BPC6**	1.1	na	0.055	<.01	<.2	<.01	<.002	na	94	352	na	na	0.03
Jul-02	**BPC6**	0.56	na	0.078	<.01	<.2	<.01	0.002	na	147	384	na	na	0.03
Aug-02	**BPC6**	1.46	na	0.093	<.01	<.2	<.01	<.002	na	129	436	na	na	<DL
Sep-02	**BPC6**	0.45	na	0.053	<.01	<.1	<.01	<.002	na	146	496	na	na	<DL
	samples analyzed	74	na	74	74	74	74	74	na	74	74	na	na	74
	detects	74	na	74	0	0	0	37	na	74	74	na	na	57
	% detects	100	na	100	0	0	0	50	na	100	100	na	na	77
	min	0.45	na	0.053	-	-	-	0.002	na	86	296	na	na	0.01
	max	5.08	na	0.383	-	-	-	0.25	na	272	1460	na	na	0.31
	mean	2.3	na	0.2	-	-	-	0.04	na	192	776	na	na	0.07

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F	Cl	NO_3-N	SO_4	Hg*	La*	Sc*	Zr*	IDC*	DOC*	TDC*	Hardness*	NO2-N*
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC6**													
Apr-94	**BPC6**													
May-94	**BPC6**													
Jun-94	**BPC6**													
Jul-94	**BPC6**													
Aug-94	**BPC6**													
Sep-94	**BPC6**													
Oct-94	**BPC6**													
Nov-94	**BPC6**													
Dec-94	**BPC6**													
Jan-95	**BPC6**													
Feb-95	**BPC6**													
Mar-95	**BPC6**													
Apr-95	**BPC6**													
May-95	**BPC6**													
Jun-95	**BPC6**													
Jul-95	**BPC6**													
Aug-95	**BPC6**													
Sep-95	**BPC6**													
Oct-95	**BPC6**													
Nov-95	**BPC6**	na	321	3.69	113	<DL	<2	<3	<.01	51.2	30.2	81.4	454	<DL
Dec-95	**BPC6**	na	359	2.94	123	<DL	<.002	<.003	<.01	58.3	39.7	98	605	<DL
Jan-96	**BPC6**	na	324	3.35	118	<DL	<.002	<.003	<.01	51.7	43.3	95	511	<DL
Feb-96	**BPC6**	na	408	2.55	118	<DL	<.002	<.003	<.01	54.8	26.3	81.1	523	<DL
Mar-96	**BPC6**	na	651	1.77	95.7	<DL	<.002	<.003	<.01	42.2	39.7	81.9	476	<DL
Apr-96	**BPC6**	na	551	1.22	93.6	0.26	<.002	<.003	<.01	36.1	39.1	75.1	391	<DL
May-96	**BPC6**	na	268	3.16	84.5	<DL	<.002	<.003	<.01	37	42.3	79.3	400	<DL
Jun-96	**BPC6**	na	232	5.71	79.7	0.1	<.002	<.003	<.01	51.1	33.7	84.8	464	<DL
Jul-96	**BPC6**	na	143	3.95	59.3	<DL	<.002	<.003	<.01	36.7	37.6	74.3	337	<DL
Aug-96	**BPC6**	na	138	0.64	60.8	<DL	<.002	<.007	<.01	32.3	31.8	64.1	357	<DL
Sep-96	**BPC6**	na	89.7	0.46	60.4	0.24	<.002	<.003	<.01	20.8	20.4	41.2	200	<DL
Oct-96	**BPC6**	na	138	0.66	69.9	<DL	<.002	<.003	<.01	34.6	11.5	46.2	257	<DL
Nov-96	**BPC6**	na	202	2.5	131	0.08	<.002	<.003	<.01	57	27	84	478	<DL
Dec-96	**BPC6**	na	160	2.14	62.2	<DL	<.002	<.003	<.01	31.8	17.5	49.3	276	<DL
Jan-97	**BPC6**	na	356	5.81	61.2	<DL	<.002	<.003	<.01	45	22.3	67.3	470	0.03
Feb-97	**BPC6**	na	221	3.56	56.4	0.17	<.002	<.003	<.01	38.5	17.1	55.5	315	<DL
Mar-97	**BPC6**	na	239	2.71	83.9	<DL	<.002	<.003		44.6	12.8	57.4	427	<DL
Apr-97	**BPC6**	na	294	2.22	87.9	<DL	<.005	<.003		53.9	28.7	82.6	443	<DL
May-97	**BPC6**	na	302.52	1.35	89.7	0.08	<.005	<.003		45.3	29.2	74.5	575	<DL
Jun-97	**BPC6**	na	299.1	0.77	80.1	<DL	<.002	<.003		53.4	12.4	65.8	401	<DL
Jul-97	**BPC6**	na	241.825	0.12	75.1	<DL	<.002	<.003		40.1	29.3	69.4	376	<DL
Aug-97	**BPC6**	na	79.475	2.7	45.8	<DL	<.002	<.003		33	1.6	34.6	232	<DL
Sep-97	**BPC6**	na	318.86	0.24	110	<DL	<.002	<.003		60.6	20.7	81.2	508	<DL
Oct-97	**BPC6**	na	202.14	0.77	164	<DL	<.002	<.003		39.4	21	60.3	413	<DL
Nov-97	**BPC6**	na	350.525	1.54	99.3	<DL	<.002	<.003		45.9	44.4	90.3	439	<DL
Dec-97	**BPC6**	na	224.78	1.07	90.1	<DL	<.002	<.003		37.6	19	56.6	382	<DL
Jan-98	**BPC6**	na	376.04	1.75	89.9	<DL	<.002	<.003		36.5	18	54.5	320	<DL
Feb-98	**BPC6**	na	272.52	2.08	80.3	<DL	<.002	<.003		35.2	2.4	37.6	366	<DL
Mar-98	**BPC6**	na	236	1.96	79	<DL	<.002	<.003		33.3	7.7	41	365	<DL
Apr-98	**BPC6**	na	185	1.2	72.2	<DL	<.002	<.003		30.5	3.6	34	300	<DL
May-98	**BPC6**	na	208	1.72	73.6	<DL	<.002	<.003		42.7	32	74.7	373	<DL
Jun-98	**BPC6**	na	167	1.8	83.3	<DL	<.002	<.003		39.3	29.8	69.1	313	<DL
Jul-98	**BPC6**	na	65.3	0.25	45.3	<DL	<.002	<.003		27.9	20.4	48.2	239	<DL
Aug-98	**BPC6**	na	102	0.05	47.5	<DL	<.002	<.003		24.4	32.7	57	227	<DL
Sep-98	**BPC6**	na	41.598	0.29	51.5	<DL	<.002	<.003		17.3	23.4	40.6	176	<DL
Oct-98	**BPC6**	na	100.345	2.13	71.6	<DL	<.002	<.003		30.7	34.9	65.5	333	<DL
Nov-98	**BPC6**	na	131	1.07	76.9	0.33	<.002	<.003		35	57.1	92.2	370	<DL
Dec-98	**BPC6**													
Jan-99	**BPC6**	na	586	1.09	87.7	<DL	<.002	<.003		33.5	20.5	54	504	<DL
Feb-99	**BPC6**	na	430	1.18	94.4	<DL	<.002	<.003		58.8	12.1	70.9	444	<DL
Mar-99	**BPC6**	na	290	1.46	95.1	<DL	<.002	<.003		56.5	11.3	67.7	449	<DL
Apr-99	**BPC6**													
May-99	**BPC6**													
Jun-99	**BPC6**													
Jul-99	**BPC6**	na	197	0.3	74.7	<DL	<.002	<.003		50.1	17.4	67.5	374	<DL
Aug-99	**BPC6**	na	147	0.93	177	<DL	<.002	<.003		56.3	20.4	76.7	533	0.41
Sep-99	**BPC6**	na	81	0.31	56.3	<DL	<.002	<.003		27	21.6	48.6	206	<DL
Oct-99	**BPC6**	na	169	0.01	102	<DL	<.002	<.003		45.3	29.1	74.4	431	<DL
Nov-99	**BPC6**													
Dec-99	**BPC6**	na	134	0.27	101	<DL	<.002	<.003		44.9	16.4	61.3	357	<DL
Jan-00	**BPC6**	na	311	0.3	114	<DL	<.002	<.003		42.2	16.1	58.3	385	<DL
Feb-00	**BPC6**	na	540	0.89	93.4	<DL	<.002	<.003		35.4	20.6	56	411	<DL
Mar-00	**BPC6**	na	446	0.16	119	<DL	<.002	<.003		44.5	22.9	67.5	503	<DL
Apr-00	**BPC6**	na	200	1.79	71.2	<DL	<.002	<.003		35.7	18	53.6	336	<DL
May-00	**BPC6**	na	144	2.06	62.1	<DL	<.002	<.003		36.8	21.4	58.3	314	<DL
Jun-00	**BPC6**	na	113	1.31	48.2	<DL	<.002	<.003		33.6	16.9	50.5	243	<DL
Jul-00	**BPC6**	na	152	0.3	84.1	<DL	<.002	<.003		44.8	17.8	62.7	369	<DL
Aug-00	**BPC6**	na	152	0.21	72	<DL	<.002	<.003		36.1	15.9	52	297	<DL
Sep-00	**BPC6**	na	145	0.19	91	<DL	<.002	<.003		31.9	17.4	49.3	282	<DL
Oct-00	**BPC6**	na	150	0.11	92.8	<DL	<.002	<.003		44.9	15.5	60.4	377	<DL
Nov-00	**BPC6**	na	202	1.45	71.7	<DL	<.002	<.003		59.2	13	72.2	434	<DL
Dec-00	**BPC6**													
Jan-01	**BPC6**													
Feb-01	**BPC6**	na	346	1.57	62.6	<DL	<.002	<.003		35	10.1	45.1	309	<DL
Mar-01	**BPC6**	na	370	1.39	92.1	<DL	<.002	<.003		55.5	16.6	72.1	445	<DL
Apr-01	**BPC6**	na	264	0.68	75.3	<DL		<.003		29	15.5	44.5	247	<DL
May-01	**BPC6**	na	313	0.5	72.4	0.18		<.003		43.6	28	71.6	371	<DL
Jun-01	**BPC6**	na	261	0.34	63.5	0.15		<.003		42.8	26.7	69.6	350	<DL
Jul-01	**BPC6**	na	197	0.12	53	<DL		<.003		31.9	5.6	37.5	241	<DL
Aug-01	**BPC6**	na	175	0.07	50.7	0.12		<.003		36.8	5	41.8	259	<DL
Sep-01	**BPC6**	na	155	0.08	47	<DL		<.003		37.1	5.4	42.6	274	<DL
Oct-01	**BPC6**	na	136	0.76	52.8	<DL		<.003		36.3	6.1	42.4	272	<DL
Nov-01	**BPC6**													
Dec-01	**BPC6**	na	165	0.44	66.5	0.08		<.003		48	0.7	48.7	334	<DL
Jan-02	**BPC6**													
Feb-02	**BPC6**	na	470	0.3	83.5	<DL		<.003		52.9	4.3	57.2	465	<DL
Mar-02	**BPC6**	na	438	1.54	83.3	<DL		<.003		45.6	5	50.6	395	<DL
Apr-02	**BPC6**	na	214	0.81	51.1	<DL		<.003		22.4	0.1	22.4	202	<DL
May-02	**BPC6**	na	163	0.29	32.7	<DL		<.003		18	2	20	145	<DL
Jun-02	**BPC6**	na	118	0.28	31.4	<DL		<.003		17	5	21.9	130	<DL
Jul-02	**BPC6**	na	135	0.12	30.6	<DL		<.003		20.7	2.6	23.3	161	<DL
Aug-02	**BPC6**	na	126	0.19	42.2	<DL		<.003		29.2	8.6	37.8	224	<DL
Sep-02	**BPC6**	na	154	0.21	43.3	<DL		<.003		34.4	11.2	45.6	107	<DL
	samples analyzed	na	74	74	74	74	58	74	16	74	74	74	74	74
	detects	na	74	74	74	11	0	0	0	74	74	74	74	2
	% detects	na	100	100	100	15	0	0	0	100	100	100	100	3
	min	na	41.598	0.01	30.6	0.08	-	-	-	17	0.1	20	107	0.03
	max	na	651	5.81	177	0.33	-	-	-	60.6	57.1	98	605	0.41
	mean	na	240	1	79	0.2	-	-	-	40	20	59	355	0.2

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Field pH	Field conductivity (µS/cm)	Field water temperature (°C)	Field turbidity (NTU)		Al mg/L	As mg/L	B mg/L	Ba mg/L	Be mg/L	Ca mg/L	Cd mg/L	Co mg/L	Cr mg/L
						MDL:	0.02/0.3	0.1	0.02/.01	0.04/0.001	0.001	0.01	0.01	0.01	0.01
Mar-94	**BPC7**														
Apr-94	**BPC7**														
May-94	**BPC7**														
Jun-94	**BPC7**														
Jul-94	**BPC7**														
Aug-94	**BPC7**														
Sep-94	**BPC7**														
Oct-94	**BPC7**														
Nov-94	**BPC7**														
Dec-94	**BPC7**														
Jan-95	**BPC7**														
Feb-95	**BPC7**														
Mar-95	**BPC7**														
Apr-95	**BPC7**														
May-95	**BPC7**														
Jun-95	**BPC7**														
Jul-95	**BPC7**														
Aug-95	**BPC7**														
Sep-95	**BPC7**														
Oct-95	**BPC7**														
Nov-95	**BPC7**	7.58	2202	4.8	1		0.04	<.1	0.08	0.06	<1	102	<.01	<.01	<.01
Dec-95	**BPC7**														
Jan-96	**BPC7**	7.43	3557	0.0	18		<.02	<.1	<.02	0.07	0.002	107	<.01	<.01	<.01
Feb-96	**BPC7**	8.20	2751	0.5	5		0.05	<.1	0.04	0.05	<.002	87.9	<.01	<.01	<.01
Mar-96	**BPC7**	7.59	5238	5.8	4		0.06	<.1	<.02	0.08	<.001	112	<.01	<.01	<.01
Apr-96	**BPC7**	7.66	4189	12.5	11		<.02	<.1	0.05	0.11	<.001	118	<.01	<.01	<.01
May-96	**BPC7**	7.50	1790	17.0	4		0.06	<.1	0.08	0.07	<.001	98.2	<.01	<.01	<.01
Jun-96	**BPC7**	7.74	1210	18.1	9		<.02	<.1	0.1	0.05	<.001	95.8	<.01	<.01	<.01
Jul-96	**BPC7**	7.55	1050	20.2	167		<.02	<.1	0.12	0.05	<.001	74.8	<.01	<.01	<.01
Aug-96	**BPC7**														
Sep-96	**BPC7**														
Oct-96	**BPC7**	7.51	1120	12.3	47		<.03	<.1	0.09	0.06	<.001	74.5	<.01	<.01	<.01
Nov-96	**BPC7**	7.26	369	2.0	65		<.02	<.1	0.06	0.04	<.001	66.3	<.01	<.01	<.01
Dec-96	**BPC7**	7.46	451	1.7	1815		0.1	<.1	0.02	0.04	<.001	50.1	<.01	<.01	<.01
Jan-97	**BPC7**	7.81	1446				0.03	<.1	0.05	0.13	<.001	116	<.01	<.01	<.01
Feb-97	**BPC7**	7.66	961	2.5	51		<.02	<.2	0.04	0.08	<.001	113	<.01	<.01	<.01
Mar-97	**BPC7**	8.56	555	11.8	26		0.03	<.1	0.07	0.05	<.001	89.9	<.01	<.01	<.01
Apr-97	**BPC7**	8.10	529	13.1	25		0.06	<.1	0.05	0.04	<.001	75.9	<.01	<.01	<.01
May-97	**BPC7**	8.23	621	12.3	5		<.04	<.2	0.09	0.06	<.002	85.1	<.01	<.01	<.01
Jun-97	**BPC7**	7.96	414	14.5	30		0.05	<.1	0.04	0.04	<.002	46.1	0.01	<.01	0.01
Jul-97	**BPC7**														
Aug-97	**BPC7**														
Sep-97	**BPC7**														
Oct-97	**BPC7**														
Nov-97	**BPC7**														
Dec-97	**BPC7**	8.16	535	1.5	66		<.02	<.3	0.05	0.04	<.002	73.3	<.01	<.01	<.01
Jan-98	**BPC7**	8.28	660	1.0	23		<.02	<.1	0.07	0.07	<.001	141	<.01	<.01	<.01
Feb-98	**BPC7**	8.58	577	7.0	11		<.02	<.2	0.05	<DL	<.001	78	<.01	<.01	<.01
Mar-98	**BPC7**	8.43	629	13.4	15		<.02	<.1	<.01	<DL	<.001	39.1	<.01	<.01	<.01
Apr-98	**BPC7**	7.97	466	14.3	30		<.02	<.1	0.04	<DL	<.001	69.1	<.01	<.01	<.01
May-98	**BPC7**														
Jun-98	**BPC7**														
Jul-98	**BPC7**														
Aug-98	**BPC7**														
Sep-98	**BPC7**														
Oct-98	**BPC7**														
Nov-98	**BPC7**														
Dec-98	**BPC7**														
Jan-99	**BPC7**														
Feb-99	**BPC7**														
Mar-99	**BPC7**	8.50	1160	10.8			0.04	<.1	0.09	0.06	<.002	134	<.01	<.01	<.01
Apr-99	**BPC7**														
May-99	**BPC7**														
Jun-99	**BPC7**														
Jul-99	**BPC7**														
Aug-99	**BPC7**														
Sep-99	**BPC7**	7.64	494	13.5	17		0.06	<.1	0.09	<DL	<.001	70.1	<.01	<.01	<.01
Oct-99	**BPC7**														
Nov-99	**BPC7**														
Dec-99	**BPC7**	8.00	1149	8.9	1		<.02	<.2	0.11	0.06	<.001	137	<.01	<.01	<.01
Jan-00	**BPC7**	7.91	1004	1.8	72		<.02	<.2	0.08	0.05	<.001	115	<.01	<.01	<.01
Feb-00	**BPC7**	7.82	629	5.3	285		<DL	<.2	0.07	0.032	<.001	69.5	<.01	<.01	<.01
Mar-00	**BPC7**	8.14	1201	5.9	8		<DL	<.1	0.12	0.058	<.001	143	<.02	<.01	<.01
Apr-00	**BPC7**	8.02	598	11.9	325		<.02	<.1	0.06	0.031	<.001	72.3	<.01	<.01	<.01
May-00	**BPC7**	8.09	1116	14.4	13		<.02	<.1	0.12	0.055	<.001	135	<.01	<.01	<.01
Jun-00	**BPC7**	8.02	1081	18.1	2		<.01	<.1	0.13	0.053	<.001	127	<.01	<.01	<.01
Jul-00	**BPC7**	8.08	1198	16.9	30		<.01	<.1	0.14	0.058	<.001	141	<.01	<.01	<.01
Aug-00	**BPC7**														
Sep-00	**BPC7**	7.95	1209	12.3	2		<.1	<.2	0.14	0.025	<.001	96.4	<.01	<.01	<.01
Oct-00	**BPC7**	7.63	1223	14.3	16		<.1	<.2	0.13	0.051	<.001	140	<.01	<.01	<.01
Nov-00	**BPC7**	7.53	1143	1.4	24		<.02	<.05	0.111	0.043	<.001	138	<.01	<.01	<.01
Dec-00	**BPC7**														
Jan-01	**BPC7**														
Feb-01	**BPC7**	7.49	803	0.5	18		<.3	<.1	<.02	0.037	<.001	67.6	<.01	<.01	<.01
Mar-01	**BPC7**	8.16	823	6.0	5		<.3	<.1	0.05	0.035	<.001	82.9	<.01	<.01	<.01
Apr-01	**BPC7**	8.35	776	17.0	73		<.02	<.1	<.01	0.022	<.001	39.5	<.01	<.01	<.01
May-01	**BPC7**														
Jun-01	**BPC7**														
Jul-01	**BPC7**	7.77	1091	25.9	43		<DL	<.1	0.06	0.045	<.001	52.3	<.01	<.01	<.01
Aug-01	**BPC7**														
Sep-01	**BPC7**	7.34	928	14.0	15		<.01	<.2	0.06	0.049	<.001	63.2	<.01	<.01	<.01
Oct-01	**BPC7**														
Nov-01	**BPC7**														
Dec-01	**BPC7**														
Jan-02	**BPC7**														
Feb-02	**BPC7**														
Mar-02	**BPC7**														
Apr-02	**BPC7**	8.00	863	12.4	15		<.1	<.1	0.07	0.029	<.001	53.4	<.01	<.01	<.01
May-02	**BPC7**	7.00	766	13.6	12		<.1	<.1	0.05	0.023	<.001	34.7	<.01	<.01	<.01
Jun-02	**BPC7**	7.51	414	17.9	1456		<.02	<.1	0.03	0.022	<.002	37.4	<.01	<.01	<.01
Jul-02	**BPC7**														
Aug-02	**BPC7**														
Sep-02	**BPC7**														
	samples analyzed						43	43	43	43	43	43	43	43	43
	detects						11	0	38	39	1	43	1	0	1
	% detects						26	0	88	91	2	100	2	0	2
	min	7.00	369	0.0	1		0.03	-	0.02	0.022	0.002	34.7	0.01	-	0.01
	max	8.58	5238	25.9	1815		0.1	-	0.14	0.13	0.002	143	0.01	-	0.01
	mean	7.86	1186	10	119		0.05	-	0.08	0.05	na	89.8	-	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

		Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date collected	Sample location	0.02/0.003	0.04/0.01	1	0.01	0.01	0.01/0.001	0.02	0.02/0.1	0.03/0.01	0.01	0.05		0.2/0.1	0.1
Mar-94	**BPC7**														
Apr-94	**BPC7**														
May-94	**BPC7**														
Jun-94	**BPC7**														
Jul-94	**BPC7**														
Aug-94	**BPC7**														
Sep-94	**BPC7**														
Oct-94	**BPC7**														
Nov-94	**BPC7**														
Dec-94	**BPC7**														
Jan-95	**BPC7**														
Feb-95	**BPC7**														
Mar-95	**BPC7**														
Apr-95	**BPC7**														
May-95	**BPC7**														
Jun-95	**BPC7**														
Jul-95	**BPC7**														
Aug-95	**BPC7**														
Sep-95	**BPC7**														
Oct-95	**BPC7**														
Nov-95	**BPC7**	<DL	<.01	<1	<.01	48.8	0.01	<.02	122	<.03	0.02	<.05	na	<.2	<.2
Dec-95	**BPC7**														
Jan-96	**BPC7**	<.01	<DL	<1	<.01	53.4	0.04	<.02	154	<.03	0.03	<.05	na	<.2	<.1
Feb-96	**BPC7**	<.01	<DL	3	<.01	46.6	0.02	<.02	108	<.03	0.02	<.08	na	<.1	<.1
Mar-96	**BPC7**	<.01	<DL	2	<.01	50.9	<.01	<.02	314	<.03	0.01	<.04	na	<.1	<.1
Apr-96	**BPC7**	<DL	<.01	5	<.01	50.1	<.01	<.02	451	<DL	0.07	<.05	na	<.1	<.2
May-96	**BPC7**	<.01	<.01	<1	<.01	46.0	<.01	<.02	147	<.03	0.04	<.05	na	<.2	<.1
Jun-96	**BPC7**	<.01	<.01	<1	<.01	44.7	<.01	<.02	53.9	<.03	0.02	<.05	na	<.2	<.2
Jul-96	**BPC7**	0.06	<.01	2	<.01	35.0	<.01	<.02	53.1	<.03	<DL	<.04	na	<.2	<.2
Aug-96	**BPC7**														
Sep-96	**BPC7**														
Oct-96	**BPC7**	<DL	<.01	4	<.01	32.3	<.01	<.02	190	<.03	0.11	<.05	na	<.2	<.2
Nov-96	**BPC7**	<DL	<.01	5	<.01	30.8	0.01	<.02	25.5	<.03	0.03	<.04	na	<.2	<.2
Dec-96	**BPC7**	0.02	<.03	3	<.01	21.2	<.01	<.02	88.6	<.03	0.14	<.05	na	<.2	<.2
Jan-97	**BPC7**	0.02	0.4	4	<.01	48.0	0.16	<.02	197	<.03	0.04	<.05	na	<.2	<.2
Feb-97	**BPC7**	0.05	<.03	<1	<.01	52.0	<.01	<.02	229	<.03	0.08	<.05	na	<.2	<.2
Mar-97	**BPC7**	<DL	<.01	2	<.01	43.9	<.01	<.02	33.9	<.03	0.04	<.05	na	<.2	<.2
Apr-97	**BPC7**	<.01	0.04	<1	<.01	41.4	0.01	<.01	14.6	<.03	0.01	<.05	na	<.1	<.1
May-97	**BPC7**	<.02	<.01	<1	<.01	54.3	0.01	<.02	42.4	<.03	0.05	<.05	na	<.2	<.2
Jun-97	**BPC7**	<.02	<.01	5	<.01	21.1	0.01	<.02	39.4	<.03	0.06	<.05	na	<.2	<.1
Jul-97	**BPC7**														
Aug-97	**BPC7**														
Sep-97	**BPC7**														
Oct-97	**BPC7**														
Nov-97	**BPC7**														
Dec-97	**BPC7**	<.02	<DL	4	<.01	32.7	0.02	0.1	11.5	<.03	0.02	<.05	na	<.2	<.2
Jan-98	**BPC7**	<.01	<.01	<1	<.01	66.7	0.03	<.02	28.7	<.03	0.02	<.05	na	<.1	<.2
Feb-98	**BPC7**	<.01	<.02	2	<.01	38.3	<.01	<.02	8.5	<.03	<DL	<.05	na	<.2	<.1
Mar-98	**BPC7**	<.01	<.01	2	<.01	18.9	<.01	<.01	5.35	<.01	<DL	<.05	na	<.2	<.1
Apr-98	**BPC7**	<.01	<.01	2	<.01	32.0	<.01	<.02	6.8	<.03	0.03	<.05	na	<.1	<.2
May-98	**BPC7**														
Jun-98	**BPC7**														
Jul-98	**BPC7**														
Aug-98	**BPC7**														
Sep-98	**BPC7**														
Oct-98	**BPC7**														
Nov-98	**BPC7**														
Dec-98	**BPC7**														
Jan-99	**BPC7**														
Feb-99	**BPC7**														
Mar-99	**BPC7**	<.01	<.01	4	0.01	55.6	<.01	<.02	44.8	<.03	0.12	0.05	na	<.2	<.2
Apr-99	**BPC7**														
May-99	**BPC7**														
Jun-99	**BPC7**														
Jul-99	**BPC7**														
Aug-99	**BPC7**														
Sep-99	**BPC7**	<.01	<DL	2	<.05	26.8	<.01	<.02	10.4	<.03	0.18	<.05	na	<.3	<.2
Oct-99	**BPC7**														
Nov-99	**BPC7**														
Dec-99	**BPC7**	<.01	<.01	3	0.02	55.0	0.02	<.02	42.6	0.05	0.26	<.05	na	<.1	<.2
Jan-00	**BPC7**	<.01	<.01	3	<.01	45.9	<.01	<.02	36.9	<.1	0.13	<.05	na	<.2	<.2
Feb-00	**BPC7**	<.01	<.01	<2	0.01	29.3	<.001	<.02	33	<.01	0.13	<.02	na	<.05	<.05
Mar-00	**BPC7**	<.01	<.01	<1	0.02	59.8	0.024	<.01	57.8	0.01	<DL	<.03	na	<.1	<.1
Apr-00	**BPC7**	<.01	0.01	4	0.01	33.6	0.009	<.01	23.3	<.01	0.04	<.02	na	<.1	<.1
May-00	**BPC7**	<.01	<.01	4	0.02	53.2	0.056	<.01	50.5	<.01	0.15	<.02	na	<.1	<.1
Jun-00	**BPC7**	<.004	<.01	3	0.018	51.7	0.053	<.01	42.6	<.01	0.15	<.03	na	<.1	<.1
Jul-00	**BPC7**	<.01	<.01	4	0.02	54.8	0.045	<.02	52.9	<.01	0.17	<.02	na	<.1	<.1
Aug-00	**BPC7**														
Sep-00	**BPC7**	<.01	<.01	<1	0.02	56.7	0.006	<.02	50	<.01	<DL	<.03	na	<.2	<.2
Oct-00	**BPC7**	<.01	<.01	3	0.02	56.5	0.002	<.02	49	<.01	0.02	<.03	na	<.2	<.2
Nov-00	**BPC7**	<.005	<.01	<1	0.01	53.8	0.026	<.01	45	<.01	0.15	<.02	na	<.1	<.1
Dec-00	**BPC7**														
Jan-01	**BPC7**														
Feb-01	**BPC7**	<.003	<.01	6	<.01	29.5	0.042	<.02	53.6	<.01	<DL	<.05	na	<.1	<.1
Mar-01	**BPC7**	<.003	<.01	4	<.01	44.5	<.001	<.02	34.7	<.01	<DL	<.05	na	<.1	<.1
Apr-01	**BPC7**	<.01	<.01	6	<.01	18.9	0.002	<.02	59.4	<.01	<DL	<.05	na	<.1	<.1
May-01	**BPC7**														
Jun-01	**BPC7**														
Jul-01	**BPC7**	<.01	<.01	4	0.01	26.6	0.013	<.02	142	<.01	<DL	<.05	na	<.1	<.1
Aug-01	**BPC7**														
Sep-01	**BPC7**	<.01	<.01	4	<.01	30.1	<.004	<.01	97.6	<.01	<DL	<.05	na	<.1	<.1
Oct-01	**BPC7**														
Nov-01	**BPC7**														
Dec-01	**BPC7**														
Jan-02	**BPC7**														
Feb-02	**BPC7**														
Mar-02	**BPC7**														
Apr-02	**BPC7**	0.01	<.01	3	<.01	34.7	0.008	<.01	56.1	<.01	0.06	<.02	na	<.1	<.1
May-02	**BPC7**	<.01	<.01	<1	<.01	21.7	0.014	<.01	43.9	<.01	<DL	<.02	na	<.1	<.1
Jun-02	**BPC7**	<.01	0.01	2	<.01	18.5	0.006	<.01	14.5	<.01	0.03	<.05	na	<.1	<.1
Jul-02	**BPC7**														
Aug-02	**BPC7**														
Sep-02	**BPC7**														
	samples analyzed	43	43	43	43	43	43	43	43	43	43	43	na	43	43
	detects	5	4	30	12	43	25	1	43	2	32	1	na	0	0
	% detects	12	9	70	28	100	58	2	100	5	74	2	na	0	0
	min	0.01	0.01	2	0.01	18.5	0.002	0.1	5.35	0.01	0.01	0.05	na	-	-
	max	0.06	0.4	6	0.02	66.7	0.16	0.1	451	0.05	0.26	0.05	na	-	-
	mean	0.03	0.1	3	0.02	41.1	0.03	-	78	0.03	0.08	-	na	-	-

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	Si	Sn	Sr	Ti	Tl	V	Zn	pH	alkalinity	TDS, 180 C	TSS	oPO_4-P	NH_3-N
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L as $CaCO_3$	mg/L	mg/L	mg/L	mg/L
		0.01		0.01/0.001	0.01	0.3/0.1	0.01	0.01/0.001		1				0.01
Mar-94	**BPC7**													
Apr-94	**BPC7**													
May-94	**BPC7**													
Jun-94	**BPC7**													
Jul-94	**BPC7**													
Aug-94	**BPC7**													
Sep-94	**BPC7**													
Oct-94	**BPC7**													
Nov-94	**BPC7**													
Dec-94	**BPC7**													
Jan-95	**BPC7**													
Feb-95	**BPC7**													
Mar-95	**BPC7**													
Apr-95	**BPC7**													
May-95	**BPC7**													
Jun-95	**BPC7**													
Jul-95	**BPC7**													
Aug-95	**BPC7**													
Sep-95	**BPC7**													
Oct-95	**BPC7**													
Nov-95	**BPC7**	4.33	na	0.13	<.01	<.4	<.01	<.01	na	241	816	na	na	0.01
Dec-95	**BPC7**													
Jan-96	**BPC7**	3.94	na	0.13	<.01	<.6	<.01	0.11	na	272	1008	na	na	0.09
Feb-96	**BPC7**	4.38	na	0.11	<.01	<.3	<.01	<.01	na	358	720	na	na	0.15
Mar-96	**BPC7**	3.38	na	0.16	<.01	<.3	<.01	<.01	na	216	1620	na	na	0.07
Apr-96	**BPC7**	4.03	na	0.23	<.01	<.3	<.01	<.01	na	217	2036	na	na	0.03
May-96	**BPC7**	4.2	na	0.13	<.01	<1	<.01	0.02	na	250	920	na	na	0.04
Jun-96	**BPC7**	5.44	na	0.11	<.01	<.6	<.01	<.01	na	281	636	na	na	0.01
Jul-96	**BPC7**	4.45	na	0.09	<.01	<.2	<.01	0.03	na	214	544	na	na	0.09
Aug-96	**BPC7**													
Sep-96	**BPC7**													
Oct-96	**BPC7**	4.36	na	0.11	<.01	<.3	<.01	0.01	na	214	884	na	na	0.03
Nov-96	**BPC7**	3.63	na	0.08	<.01	<.3	<.01	<.01	na	176	440	na	na	0.04
Dec-96	**BPC7**	2.41	na	0.07	<.01	<.3	<.01	0.01	na	104	552	na	na	0.1
Jan-97	**BPC7**	4.33	na	0.17	<.01	<.3	<.01	<.01	na	232	940	na	na	<DL
Feb-97	**BPC7**	4.45	na	0.15	<.01	<.3	<.01	0.03	na	243	1152	na	na	0.04
Mar-97	**BPC7**	2.27	na	0.1	<.01	<.3	<.01	0.2	na	266	532	na	na	0.09
Apr-97	**BPC7**	2	na	0.08	<.01	<0	<.01	0.01	na	344	396	na	na	0.05
May-97	**BPC7**	0.08	na	0.11	<.01	<.3	<.01	0.02	na	291	632	na	na	0.09
Jun-97	**BPC7**	1.35	na	0.06	<.01	<.3	<.01	<.01	na	146	488	na	na	0.12
Jul-97	**BPC7**													
Aug-97	**BPC7**													
Sep-97	**BPC7**													
Oct-97	**BPC7**													
Nov-97	**BPC7**													
Dec-97	**BPC7**	3.53	na	0.08	<.01	<.3	<.01	0.02	na	188	424	na	na	<DL
Jan-98	**BPC7**	6.74	na	0.14	<.01	<.3	<.01	<.01	na	252	476	na	na	0.07
Feb-98	**BPC7**	3.21	na	0.07	<.01	<.2	<.01	<.01	na	229	372	na	na	<DL
Mar-98	**BPC7**	1.47	na	0.04	<.01	<.2	<.01	<.01	na	223	360	na	na	0.04
Apr-98	**BPC7**	2.56	na	0.08	<.01	<.3	<.01	<.01	na	209	380	na	na	<DL
May-98	**BPC7**													
Jun-98	**BPC7**													
Jul-98	**BPC7**													
Aug-98	**BPC7**													
Sep-98	**BPC7**													
Oct-98	**BPC7**													
Nov-98	**BPC7**													
Dec-98	**BPC7**													
Jan-99	**BPC7**													
Feb-99	**BPC7**													
Mar-99	**BPC7**	6.49	na	0.68	<.01	<.3	<.01	<.01	na	320	772	na	na	0.22
Apr-99	**BPC7**													
May-99	**BPC7**													
Jun-99	**BPC7**													
Jul-99	**BPC7**													
Aug-99	**BPC7**													
Sep-99	**BPC7**	3.64	na	0.22	<.01	<.3	<.01	<.01	na	157	400	na	na	0.07
Oct-99	**BPC7**													
Nov-99	**BPC7**													
Dec-99	**BPC7**	6.55	na	0.68	<.01	<.5	<.01	<.01	na	329	744	na	na	0.13
Jan-00	**BPC7**	4.6	na	0.48	<.01	<.3	<.01	<.01	na	267	660	na	na	<DL
Feb-00	**BPC7**	3.21	na	0.256	<.01	<.1	<.01	0.002	na	165	432	na	na	0.01
Mar-00	**BPC7**	5.87	na	0.892	<.01	<.1	<.01	0.023	na	275	744	na	na	<DL
Apr-00	**BPC7**	3.31	na	0.277	<.01	<.1	<.01	0.003	na	192	440	na	na	0.08
May-00	**BPC7**	5.81	na	0.775	<.01	<.1	<.01	0.013	na	318	748	na	na	0.1
Jun-00	**BPC7**	6	na	0.76	<.01	<.1	<.01	<.001	na	322	720	na	na	0.12
Jul-00	**BPC7**	6.35	na	0.963	<.01	<.1	<.01	<.01	na	318	828	na	na	0.08
Aug-00	**BPC7**													
Sep-00	**BPC7**	5.2	na	0.679	<.01	<.2	<.01	<.01	na	182	732	na	na	<DL
Oct-00	**BPC7**	5.8	na	0.863	<.01	<.2	<.01	<.01	na	321	768	na	na	0.01
Nov-00	**BPC7**	5.64	na	0.708	<.01	<.1	<.01	<.002	na	312	756	na	na	0.04
Dec-00	**BPC7**													
Jan-01	**BPC7**													
Feb-01	**BPC7**	2.07	na	0.089	<.01	<.1	<.01	<.01	na	180	476	na	na	0.04
Mar-01	**BPC7**	0.51	na	0.121	<.01	<.1	<.01	<.01	na	241	412	na	na	<DL
Apr-01	**BPC7**	0.69	na	0.064	<.01	<.1	<.01	<.005	na	59	628	na	na	0.06
May-01	**BPC7**													
Jun-01	**BPC7**													
Jul-01	**BPC7**	1.23	na	0.111	<.01	<.2	<.01	<.01	na	120	640	na	na	0.03
Aug-01	**BPC7**													
Sep-01	**BPC7**	1.22	na	0.118	<.01	<.1	<.01	<.01	na	174	592	na	na	<DL
Oct-01	**BPC7**													
Nov-01	**BPC7**													
Dec-01	**BPC7**													
Jan-02	**BPC7**													
Feb-02	**BPC7**													
Mar-02	**BPC7**													
Apr-02	**BPC7**	1.28	na	0.093	<.01	<.2	<.01	<.001	na	178	448	na	na	<DL
May-02	**BPC7**	1.36	na	0.052	<.01	<.2	<.01	0.004	na	151	320	na	na	<DL
Jun-02	**BPC7**	1.87	na	0.051	<.01	<.2	<.01	<.002	na	147	248	na	na	<DL
Jul-02	**BPC7**													
Aug-02	**BPC7**													
Sep-02	**BPC7**													
	samples analyzed	43	na	43	43	43	43	43	na	43	43	na	na	43
	detects	43	na	43	0	0	0	15	na	43	43	na	na	31
	% detects	100	na	100	0	0	0	35	na	100	100	na	na	72
	min	0.08	na	0.04	-	-	-	0.002	na	59	248	na	na	0.01
	max	6.74	na	0.963	-	-	-	0.2	na	358	2036	na	na	0.22
	mean	4	na	0.3	-	-	-	0.03	na	230	671	na	na	0.07

APPENDIX E: Field Parameters and Results of Geochemical Analysis of Grab Samples Collected by INHS from Mar. 1994-Sept. 2002 (Soluk et al. 2003)

Date collected	Sample location	F	Cl	NO_3-N	SO_4	Hg*	La*	Sc*	Zr*	IDC*	DOC*	TDC*	Hardness*	NO2-N*
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			0.01	0.01	0.01	0.05	0.002	0.003	0.01	0.1	0.1	0.1	5	0.01
Mar-94	**BPC7**													
Apr-94	**BPC7**													
May-94	**BPC7**													
Jun-94	**BPC7**													
Jul-94	**BPC7**													
Aug-94	**BPC7**													
Sep-94	**BPC7**													
Oct-94	**BPC7**													
Nov-94	**BPC7**													
Dec-94	**BPC7**													
Jan-95	**BPC7**													
Feb-95	**BPC7**													
Mar-95	**BPC7**													
Apr-95	**BPC7**													
May-95	**BPC7**													
Jun-95	**BPC7**													
Jul-95	**BPC7**													
Aug-95	**BPC7**													
Sep-95	**BPC7**													
Oct-95	**BPC7**													
Nov-95	**BPC7**	na	249	4.66	100	<DL	<2	<3	<.01	50.1	29.4	79.6	456	<DL
Dec-95	**BPC7**													
Jan-96	**BPC7**	na	287	0.83	96.4	<DL	<.002	<.003	<.01	59.9	46.2	106.1	487	<DL
Feb-96	**BPC7**	na	130	0.14	102	<DL	<.002	<.003	<.01	75.9	36.3	112.2	412	<DL
Mar-96	**BPC7**	na	741	2.71	84.1	<DL	<.002	<.003	<.01	41.8	43.8	85.6	490	<DL
Apr-96	**BPC7**	na	892	1.09	118	0.08	<.002	<.003	<.01	40.3	36.1	76.5	501	<DL
May-96	**BPC7**	na	266	4.85	77.3	0.05	<.002	<.003	<.01	43.7	44.7	88.4	435	<DL
Jun-96	**BPC7**	na	97	7.97	57.8	0.08	<.002	<.003	<.01	54.2	33.1	87.3	423	<DL
Jul-96	**BPC7**	na	93.4	5.96	47.8	<DL	<.002	<.003	<.01	38.2	39.5	77.7	331	<DL
Aug-96	**BPC7**													
Sep-96	**BPC7**													
Oct-96	**BPC7**	na	308	1.93	85.7	<DL	<.002	<.003	<.01	45.5	17.5	63.1	319	<DL
Nov-96	**BPC7**	na	55.7	<DL	61.7	0.12	<.002	<.003	<.01	37.1	21.8	58.8	292	<DL
Dec-96	**BPC7**	na	162	3.48	54.2	<DL	<.002	<.003	<.01	23.6	16.3	39.9	213	<DL
Jan-97	**BPC7**	na	312	3.49	70.5	<DL	<.002	<.003	<.01	48.7	23.1	71.8	489	<DL
Feb-97	**BPC7**	na	424	7.25	70.7	0.26	<.002	<.003	<.01	55.7	22.8	78.5	496	<DL
Mar-97	**BPC7**	na	41.6	0.3	70.1	<DL	<.002	<.003		60.5	17.5	78	406	<DL
Apr-97	**BPC7**	na	16.5	<DL	38.7	<DL	<.005	<.003		73.1	32.3	105.5	360	<DL
May-97	**BPC7**	na	87.43	<DL	58.5	<DL	<.005	<.003		54.3	35.6	89.9	436	<DL
Jun-97	**BPC7**	na	67.6	1.3	47.7	<DL	<.002	<.003		32.2	18.5	50.7	202	0.39
Jul-97	**BPC7**													
Aug-97	**BPC7**													
Sep-97	**BPC7**													
Oct-97	**BPC7**													
Nov-97	**BPC7**													
Dec-97	**BPC7**	na	19.2	3.59	71.3	<DL	<.002	<.003		38.3	18.8	57	318	<DL
Jan-98	**BPC7**	na	21.71	2.66	70.4	0.1	<.002	<.003		46	22	68	627	<DL
Feb-98	**BPC7**	na	16.8	3.44	69.6	<DL	<.002	<.003		42.4	<DL	40.8	352	<DL
Mar-98	**BPC7**	na	16.8	3.34	61.5	0.11	<.002	<.003		39.6	3.1	42.8	175	<DL
Apr-98	**BPC7**	na	9.66	1.97	70	<DL	<.002	<.003		36.3	3.5	39.8	304	<DL
May-98	**BPC7**													
Jun-98	**BPC7**													
Jul-98	**BPC7**													
Aug-98	**BPC7**													
Sep-98	**BPC7**													
Oct-98	**BPC7**													
Nov-98	**BPC7**													
Dec-98	**BPC7**													
Jan-99	**BPC7**													
Feb-99	**BPC7**													
Mar-99	**BPC7**	na	86	0.64	156	<DL	<.002	<.003		75.9	11.4	87.3	564	<DL
Apr-99	**BPC7**													
May-99	**BPC7**													
Jun-99	**BPC7**													
Jul-99	**BPC7**													
Aug-99	**BPC7**													
Sep-99	**BPC7**	na	30	1.44	89.3	<DL	<.002	<.003		34	25.9	60	286	<DL
Oct-99	**BPC7**													
Nov-99	**BPC7**													
Dec-99	**BPC7**	na	102	0.08	168	<DL	<.002	<.003		73	17.4	90.4	569	<DL
Jan-00	**BPC7**	na	85	1.53	143	<DL	<.002	<.003		58.2	20.6	78.8	477	<DL
Feb-00	**BPC7**	na	48	1.95	74.7	<DL	<.002	<.003		35.7	21.8	57.5	295	<DL
Mar-00	**BPC7**	na	116	0.07	163	<DL	<.002	<.003		65.6	28.7	94.3	604	<DL
Apr-00	**BPC7**	na	39	0.39	90.9	<DL	<.002	<.003		36	16.3	52.3	319	0.18
May-00	**BPC7**	na	92	0.19	143	<DL	<.002	<.003		65.2	25.3	90.5	557	<DL
Jun-00	**BPC7**	na	92	0.13	142	<DL	<.002	<.003		65.2	20.7	85.9	531	<DL
Jul-00	**BPC7**	na	117	0.1	163	<DL	<.002	<.003		68	23.9	91.9	579	<DL
Aug-00	**BPC7**													
Sep-00	**BPC7**	na	145	0.15	227	<DL	<.002	<.003		46.1	14.5	60.6	475	<DL
Oct-00	**BPC7**	na	115	0.13	166	<DL	<.002	<.003		70.6	18.5	89.1	583	<DL
Nov-00	**BPC7**	na	101	0.2	149	<DL	<.002	<.003		73.1	12.8	85.8	567	<DL
Dec-00	**BPC7**													
Jan-01	**BPC7**													
Feb-01	**BPC7**	na	104	1.12	60.3	<DL	<.002	<.003		42.4	10.1	52.5	290	<DL
Mar-01	**BPC7**	na	72	0.21	74.1	<DL	<.002	<.003		55.7	15.6	71.3	390	<DL
Apr-01	**BPC7**	na	124	0.96	66.3	<DL		<.003		20.4	3.7	24.1	177	<DL
May-01	**BPC7**													
Jun-01	**BPC7**													
Jul-01	**BPC7**	na	227	0.17	56.9	<DL		<.003		29.3	5.7	35.1	240	<DL
Aug-01	**BPC7**													
Sep-01	**BPC7**	na	161	0.06	47.2	<DL		<.003		38.6	6.2	44.7	282	<DL
Oct-01	**BPC7**													
Nov-01	**BPC7**													
Dec-01	**BPC7**													
Jan-02	**BPC7**													
Feb-02	**BPC7**													
Mar-02	**BPC7**													
Apr-02	**BPC7**	na	96	0.08	66.2	<DL		<.003		36.4	0.2	36.6	276	<DL
May-02	**BPC7**	na	79	0.16	36.5	<DL		<.003		24.5	3.5	28	176	<DL
Jun-02	**BPC7**	na	24	0.43	27.5	<DL		<.003		27.7	8.7	36.4	170	<DL
Jul-02	**BPC7**													
Aug-02	**BPC7**													
Sep-02	**BPC7**													
	samples analyzed	na	43	43	43	43	37	43	13	43	43	43	43	43
	detects	na	43	40	43	7	0	0	0	43	42	43	43	2
	% detects	na	100	93	100	16	0	0	0	100	98	100	100	5
	min	na	9.66	0.06	27.5	0.05	-	-	-	20.4	0.2	24.1	170	0.18
	max	na	892	7.97	227	0.26	-	-	-	75.9	46.2	112.2	627	0.39
	mean	na	148	2	91	0.1	-	-	-	48	21	69	394	0.29

APPENDIX F: Comparison of Pre- and Post-Construction Geochemistry for Selected Analytes

Sample location		Total Dissolved Solids	Sodium	Chloride	Calcium	Magnesium	Alkalinity	Sulfate	Potassium	Nitrate	Copper	Manganese
Seep												
BPC5 (INHS)	samples analyzed	89	89	89	89	89	89	89	89	89	89	89
	detects	89	89	89	89	89	89	89	75	89	10	58
	% detects	100	100	100	100	100	100	100	84	100	11	65
	min	440	34.8	77	38.9	26.7	144	57	2	0.11	0.003	0.001
	max	1,216	191	475	142	66.6	378	149	7	1.34	0.07	0.024
	mean	732	67.5	134	106	52.7	307	101	3	0.43	0.02	0.01
BPC5 (ISGS)	samples analyzed	11	11	11	11	11	11	11	11	11	11	11
	detects	11	11	11	11	11	11	11	11	8	1	5
	% detects	100	100	100	100	100	100	100	100	73	9	45
	min	691	64.0	129	109	50.5	337	91.9	3.04	0.10	0.00095	0.0024
	max	797	81.0	149	121	56.5	343	110.5	3.75	0.19	0.00095	0.0083
	mean	716	72.7	136	113	53.1	341	103	3.44	0.13	0.00095	0.0057
	percent change min	*57*	*84*	*68*	*180*	*89*	*134*	*61*	*52*	*-11*	*-68*	*142*
	percent change max	*-34*	*-58*	*-69*	*-15*	*-15*	*-9*	*-26*	*-46*	*-86*	*-99*	*-65*
	percent change mean	*-2*	↑ **8**	*2*	↑ **6**	*1*	↑ **11**	*2*	*5*	↓ **-69**	*-96*	*-44*
I-355 Tributary												
BPC7 (INHS)	samples analyzed	43	43	43	43	43	43	43	43	43	43	43
	detects	43	43	43	43	43	43	43	30	40	5	25
	% detects	100	100	100	100	100	100	100	70	93	12	58
	min	248	5.35	9.66	34.7	18.5	59	27.5	2	0.06	0.01	0.002
	max	2,036	451	892	143	66.7	358	227	6	7.97	0.06	0.16
	mean	671	78.3	148	89.8	41.1	230	90.6	3.47	2	0.03	0.03
BPC7 (ISGS)	samples analyzed	9	9	9	9	9	9	9	9	9	9	9
	detects	9	9	9	9	9	9	9	9	5	4	7
	% detects	100	100	100	100	100	100	100	100	56	44	78
	min	481	129	173	32.5	12.2	112	19.0	5.14	0.05	0.00122	0.0016
	max	1,896	518	951	122.1	51.6	248	80.0	9.62	0.10	0.00154	0.0140
	mean	956	259	438	63.6	25.9	160	42.4	7.57	0.08	0.00135	0.0065
	percent change min	*94*	*2,310*	*1,689*	*-6*	*-34*	*90*	*-31*	*157*	*-10*	*-88*	*-21*
	percent change max	*-7*	*15*	*7*	*-15*	*-23*	*-31*	*-65*	*60*	*-99*	*-97*	*-91*
	percent change mean	*42*	↑ **231**	↑ **196**	*-29*	↓ **-37**	↓ **-30**	↓ **-53**	↑ **119**	↓ **-95**	*-96*	*-75*
In-stream (upstream to downstream)												
BPC3 (INHS)	samples analyzed	87	87	87	87	87	87	87	87	87	87	87
	detects	87	87	87	87	87	87	87	72	86	17	68
	% detects	100	100	100	100	100	100	100	83	99	20	78
	min	284	32.4	54	25.6	12.7	68	28.5	1	0.02	0.003	0.001
	max	2,244	638	1232	136	64.4	272	154	7	5.53	0.1	0.29
	mean	835	151	277	80.3	39.2	195	77.6	3	1	0.02	0.05
BPC3 (ISGS)	samples analyzed	11	11	11	11	11	11	11	11	11	11	11
	detects	11	11	11	11	11	11	11	11	10	6	10
	% detects	100	100	100	100	100	100	100	100	91	55	91
	min	339	78.4	112	30.3	14.0	105	27.6	2.35	0.07	0.00110	0.0095
	max	1,182	302.7	534	91.5	39.5	229	75.2	3.51	0.43	0.00243	0.0412
	mean	700	166	273	57.7	26.2	165	51.5	3.04	0.2	0.00187	0.024
	percent change min	*19*	*142*	*108*	*18*	*10*	*55*	*-3*	*135*	*268*	*-63*	*850*
	percent change max	*-47*	*-53*	*-57*	*-33*	*-39*	*-16*	*-51*	*-50*	*-92*	*-98*	*-86*
	percent change mean	*-16*	*10*	*-1*	↓ **-28**	↓ **-33**	*-15*	↓ **-34**	↓ **-11**	↓ **-83**	*-92*	*-54*
BPC6 (INHS)	samples analyzed	74	74	74	74	74	74	74	74	74	74	74
	detects	74	74	74	74	74	74	74	57	74	16	49
	% detects	100	100	100	100	100	100	100	77	100	22	66
	min	296	27.1	42	23.1	12	86	30.6	2	0.01	0.003	0.002
	max	1,460	346	651	136	65	272	177	10	5.81	0.08	0.21
	mean	776	132	240	78.9	38	192	78.7	4	1	0.03	0.03
BPC6 (ISGS)	samples analyzed	11	11	11	11	11	11	11	11	11	11	11
	detects	11	11	11	11	11	11	11	11	10	7	10
	% detects	100	100	100	100	100	100	100	100	91	64	91
	min	428	102	150	35.5	14.1	108	25.9	2.45	0.09	0.00103	0.0096
	max	1,228	319	574	94.4	38.5	219	74.3	3.78	0.43	0.00216	0.0618
	mean	717	175	287	57.5	25.2	162	50.3	3.24	0.2	0.00148	0.023
	percent change min	*45*	*276*	*261*	*53*	*17*	*25*	*-15*	*22*	*824*	*-66*	*380*
	percent change max	*-16*	*-8*	*-12*	*-31*	*-41*	*-19*	*-58*	*-62*	*-93*	*-97*	*-71*
	percent change mean	*-8*	*33*	*19*	↓ **-27**	↓ **-33**	↓ **-16**	↓ **-36**	↓ **-16**	↓ **-82**	*-95*	*-29*
BPC2 (INHS)	samples analyzed	89	89	89	89	89	89	89	89	89	89	89
	detects	89	89	89	89	89	89	89	72	89	10	63
	% detects	100	100	100	100	100	100	100	81	100	11	71
	min	324	24.5	48	23.3	15.2	78	27.6	2	0.06	0.003	0.001
	max	1,508	408	758	128	62.7	330	139	9	5.66	0.11	0.11
	mean	758	113	208	86.4	41.8	223	87.9	3	1	0.03	0.01
BPC2 (ISGS)	samples analyzed	11	11	11	11	11	11	11	11	11	11	11
	detects	11	11	11	11	11	11	11	11	11	6	10
	% detects	100	100	100	100	100	100	100	100	100	55	91
	min	403	95.4	142	34.9	14.0	115	24.9	2.42	0.08	0.00092	0.0042
	max	1,171	275.8	501	94.5	43.1	249	82.7	3.74	0.32	0.00318	0.0130
	mean	698	155	256	63.9	28.7	182	57.1	3.29	0.2	0.0016	0.0070
	percent change min	*24*	*289*	*195*	*50*	*-8*	*48*	*-10*	*21*	*31*	*-69*	*317*
	percent change max	*-22*	*-32*	*-34*	*-26*	*-31*	*-25*	*-41*	*-58*	*-94*	*-97*	*-88*
	percent change mean	*-8*	*36*	*23*	↓ **-26**	↓ **-31**	↓ **-18**	↓ **-35**	*-4*	↓ **-83**	*-94*	*-49*
BPC1 (INHS)	samples analyzed	89	89	89	89	89	89	89	89	89	89	89
	detects	89	89	89	89	89	89	89	77	89	9	63
	% detects	100	100	100	100	100	100	100	87	100	10	71
	min	336	28.3	54	30.8	15.4	80	41.7	2	0.01	0.009	0.002
	max	1,488	405	697	149	61.7	338	142	6	8.96	0.15	0.19
	mean	744	108	198	86.9	42.0	226	88.7	3	1	0.04	0.02
BPC1 (ISGS)	samples analyzed	11	11	11	11	11	11	11	11	11	11	11
	detects	11	11	11	11	11	11	11	11	10	6	10
	% detects	100	100	100	100	100	100	100	100	91	55	91
	min	401	94.1	133	32.5	12.5	107	23.1	2.35	0.09	0.00088	0.0049
	max	1,163	276.2	496	95.4	43.5	253	83.1	3.81	0.33	0.00300	0.0184
	mean	705	156	256	65.1	29.1	184	57.3	3.33	0.2	0.0014	0.0072
	percent change min	*19*	*232*	*144*	*5*	*-19*	*33*	*-45*	*17*	*783*	*-90*	*146*
	percent change max	*-22*	*-32*	*-29*	*-36*	*-29*	*-25*	*-41*	*-36*	*-96*	*-98*	*-90*
	percent change mean	*-5*	*44*	*30*	↓ **-25**	↓ **-31**	↓ **-19**	↓ **-35**	*-0.3*	↓ **-81**	*-96*	*-59*

percent increase
percent decrease

↑ **statistically significant percent increase**
↓ **statistically significant percent decrease**

APPENDIX G: Statistical Analysis of Select Pre- and Post-Construction Analystes Using a Two-Sample T-test, Assuming Unequal Variances

	BPC1 (stream)		BPC2 (stream)		BPC3 (stream)		BPC5 (seep)		BPC6 (stream)		BPC7 (I-355 tributary)	
TDS												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	744.4044944	704.9090909	758.0674157	697.7272727	835.4942529	699.7272727	732.0449438	715.9090909	776.4864865	717.4545455	670.6046512	955.5555556
Variance	48885.10725	83278.49091	54545.85904	84961.01818	108648.8575	100518.2182	12379.4525	826.8909091	70982.99297	101870.0727	110019.7209	290336.7778
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	11		12		13		58		12		9	
t Stat	0.438295888		0.660863484		1.33214677		1.102337066		0.583926961		-1.527097027	
P(T<=t) one-tail	0.334827458		0.260592807		0.102847556		0.137434193		0.285041637		0.080541621	
t Critical one-tail	1.795884819		1.782287556		1.770933396		1.671552762		1.782287556		1.833112933	
P(T<=t) two-tail	0.669654916		0.521185614		0.205695113		0.274868386		0.570083275		0.161083243	
t Critical two-tail	2.20098516		2.17881283		2.160368656		2.001717484		2.17881283		2.262157163	
SODIUM												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	108.0348315	155.9323509	113.4977528	154.5783046	151.0931034	165.7869242	67.46741573	72.72927718	131.8918919	175.2521702	78.25232558	259.1902364
Variance	3837.112523	5145.901998	4279.033631	5117.569994	9894.197394	7185.190026	333.6394944	29.49421084	4850.038016	7693.016255	7735.399875	22851.94467
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	12		12		14		47		12		9	
t Stat	-2.119021383		-1.813198198		-0.530588886		-2.075067481		-1.567790324		-3.469965276	
P(T<=t) one-tail	0.027815883		0.047436736		0.302009438		0.021739706		0.07145441		0.003524576	
t Critical one-tail	1.782287556		1.782287556		1.761310136		1.677926722		1.782287556		1.833112933	
P(T<=t) two-tail	0.055631766		0.094873473		0.604018875		0.043479412		0.142908821		0.007049152	
t Critical two-tail	2.17881283		2.17881283		2.144786688		2.011740514		2.17881283		2.262157163	
CHLORIDE												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	197.5726517	255.9364534	207.9268539	256.0237805	276.9006322	273.1321797	133.6305056	135.8473367	240.3747027	286.794051	148.1255814	437.7635653
Variance	11541.97575	18553.68845	13875.32155	18681.98323	32251.76044	25636.53312	1999.7452	38.61956349	16719.08171	27541.75794	31228.81682	87598.8743
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	12		12		13		97		12		9	
t Stat	-1.369429664		-1.116944185		0.072506398		-0.434924353		-0.888462733		-2.832049814	
P(T<=t) one-tail	0.097974069		0.142941615		0.471651299		0.332291722		0.195876633		0.009828267	
t Critical one-tail	1.782287556		1.782287556		1.770933396		1.66071461		1.782287556		1.833112933	
P(T<=t) two-tail	0.195948138		0.285883229		0.943302598		0.664583444		0.391753265		0.019656534	
t Critical two-tail	2.17881283		2.17881283		2.160368656		1.984723186		2.17881283		2.262157163	
CALCIUM												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	86.86853933	65.09819551	86.44606742	63.8808618	80.3045977	57.74264266	106.3865169	113.0550946	78.85945946	57.53425841	89.82325581	63.647366
Variance	616.3967263	546.0676572	595.7788764	490.313479	586.3706763	457.0589355	368.4507252	13.48029919	619.3290189	448.1114152	1090.270399	1357.219636
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	13		13		13		83		14		11	
t Stat	2.894533942		3.151488271		3.246720894		-2.878943077		3.043145407		1.972200762	
P(T<=t) one-tail	0.006269389		0.003824843		0.00318415		0.002536752		0.004384125		0.037126098	
t Critical one-tail	1.770933396		1.770933396		1.770933396		1.663420175		1.761310136		1.795884819	
P(T<=t) two-tail	0.012538778		0.007649687		0.0063683		0.005073503		0.00876825		0.074252196	
t Critical two-tail	2.160368656		2.160368656		2.160368656		1.98895978		2.144786688		2.20098516	
MAGNESIUM												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	42.03820225	29.09250459	41.80674157	28.68031233	39.24827586	26.24896093	52.67078652	53.05300175	37.85945946	25.1913297	41.07674419	25.89238665
Variance	129.9819331	131.680146	134.1826813	122.4562859	140.2443865	107.4630488	42.50254597	4.167260013	128.4112107	92.93205455	173.626113	256.4708404
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	13		13		14		43		14		10	
t Stat	3.532359716		3.692087889		3.85321415		-0.413019008		3.969727168		2.662096789	
P(T<=t) one-tail	0.001839322		0.001355316		0.000878191		0.340822528		0.000698295		0.011906712	
t Critical one-tail	1.770933396		1.770933396		1.761310136		1.681070703		1.761310136		1.812461123	
P(T<=t) two-tail	0.003678645		0.002710632		0.001756383		0.681645056		0.001396589		0.023813424	
t Critical two-tail	2.160368656		2.160368656		2.144786688		2.016692199		2.144786688		2.228138852	
ALKALINITY												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	225.9550562	183.7151818	222.7865169	181.8803636	194.9655172	164.8328182	306.7303371	340.9685455	191.9459459	161.5359091	230.0930233	160.2402222
Variance	3080.770684	2657.227791	3147.897089	2502.452691	2072.963913	2040.752151	1421.608274	3.210830273	2091.394298	1806.36558	4890.610188	2613.173074
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	13		13		13		91		14		15	
t Stat	2.541705775		2.523027513		2.082578852		-8.489531527		2.191933481		3.474929663	
P(T<=t) one-tail	0.012287557		0.012729022		0.028801771		1.84032E-13		0.022893525		0.001696853	
t Critical one-tail	1.770933396		1.770933396		1.770933396		1.661771155		1.761310136		1.753050356	
P(T<=t) two-tail	0.024575115		0.025458044		0.057603541		3.68064E-13		0.045787049		0.003393707	
t Critical two-tail	2.160368656		2.160368656		2.160368656		1.986377154		2.144786688		2.131449546	
SULFATE												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	88.66741573	57.32331639	87.87730337	57.09199482	77.57126437	51.53423221	100.9179775	103.066978	78.72162162	50.2964602	90.55581395	42.43082736
Variance	640.1190398	478.7450834	638.7306563	463.7892841	506.6174205	370.6765251	288.530355	50.7606969	761.9313069	334.9668408	2017.502049	458.9383389
Observations	89	11	89	11	87	11	89	11	74	11	43	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	14		14		14		27		18		25	
t Stat	4.401383068		4.379901		4.141686445		-0.766692671		4.452975687		4.863546829	
P(T<=t) one-tail	0.000301603		0.000314341		0.0004988		0.224958202		0.000153647		2.65327E-05	
t Critical one-tail	1.761310136		1.761310136		1.761310136		1.703288446		1.734063607		1.708140761	
P(T<=t) two-tail	0.000603206		0.000628681		0.000997601		0.449916405		0.000307293		5.30654E-05	
t Critical two-tail	2.144786688		2.144786688		2.144786688		2.051830516		2.10092204		2.059538553	
POTASSIUM												
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	3.337662338	3.326612213	3.416666667	3.290196787	3.430555556	3.042788766	3.266666667	3.440217386	3.842105263	3.243840608	3.466666667	7.574672752
Variance	0.805536569	0.185070093	1.401408451	0.147993273	1.26271518	0.150701012	1.036036036	0.050814072	1.84962406	0.140967377	1.429885057	2.086391939
Observations	77	11	72	11	72	11	75	11	57	11	30	9
Hypothesized Mean Difference	0		0		0		0		0		0	
df	25		46		42		72		58		11	
t Stat	0.066895471		0.69706099		2.193968417		-1.278277572		2.811986492		-7.770562849	
P(T<=t) one-tail	0.473598521		0.244636325		0.016911313		0.102628526		0.003353536		4.30245E-06	
t Critical one-tail	1.708140761		1.678660414		1.681952357		1.666293696		1.671552762		1.795884819	
P(T<=t) two-tail	0.947197043		0.489272651		0.033822627		0.205257052		0.006707071		8.6049E-06	
t Critical two-tail	2.059538553		2.012895599		2.018081703		1.993463567		2.001717484		2.20098516	

statistcally significant increase between means of pre- and post-construction sample populations

statistcally significant decrease between means of pre- and post-construction sample populations

APPENDIX G: Statistical Analysis of Select Pre- and Post-Construction Analystes Using a Two-Sample T-test, Assuming Unequal Variances

NITRATE	BPC1 (stream)		BPC2 (stream)		BPC3 (stream)		BPC5 (seep)		BPC6 (stream)		BPC7 (I-355 tributary)	
	Before I-355	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*	*Before I-355*	*After I-355*
Mean	1.089213483	0.208385234	1.135617978	0.196059951	1.282209302	0.211948144	0.430224719	0.132629798	1.296081081	0.231972091	1.77875	0.083278003
Variance	1.364695965	0.006135944	1.046931716	0.005456917	1.437516238	0.013945935	0.074415858	0.001075515	1.578840596	0.010208162	4.296329167	0.000319386
Observations	89	10	89	11	86	10	89	8	74	10	40	5
Hypothesized Mean Difference	0		0		0		0		0		0	
df	94		94		94		89		79		39	
t Stat	6.975064674		8.485739372		7.953014154		9.552377911		7.116790903		5.171812132	
P(T<=t) one-tail	2.11082E-10		1.51293E-13		2.00291E-12		1.34868E-15		2.23226E-10		3.63639E-06	
t Critical one-tail	1.661225855		1.661225855		1.661225855		1.662155326		1.664371409		1.684875122	
P(T<=t) two-tail	4.22163E-10		3.02585E-13		4.00582E-12		2.69735E-15		4.46452E-10		7.27278E-06	
t Critical two-tail	1.985523442		1.985523442		1.985523442		1.9869787		1.99045021		2.02269092	

statistcally significant increase between means of pre- and post-construction sample populations

statistcally significant decrease between means of pre- and post-construction sample populations